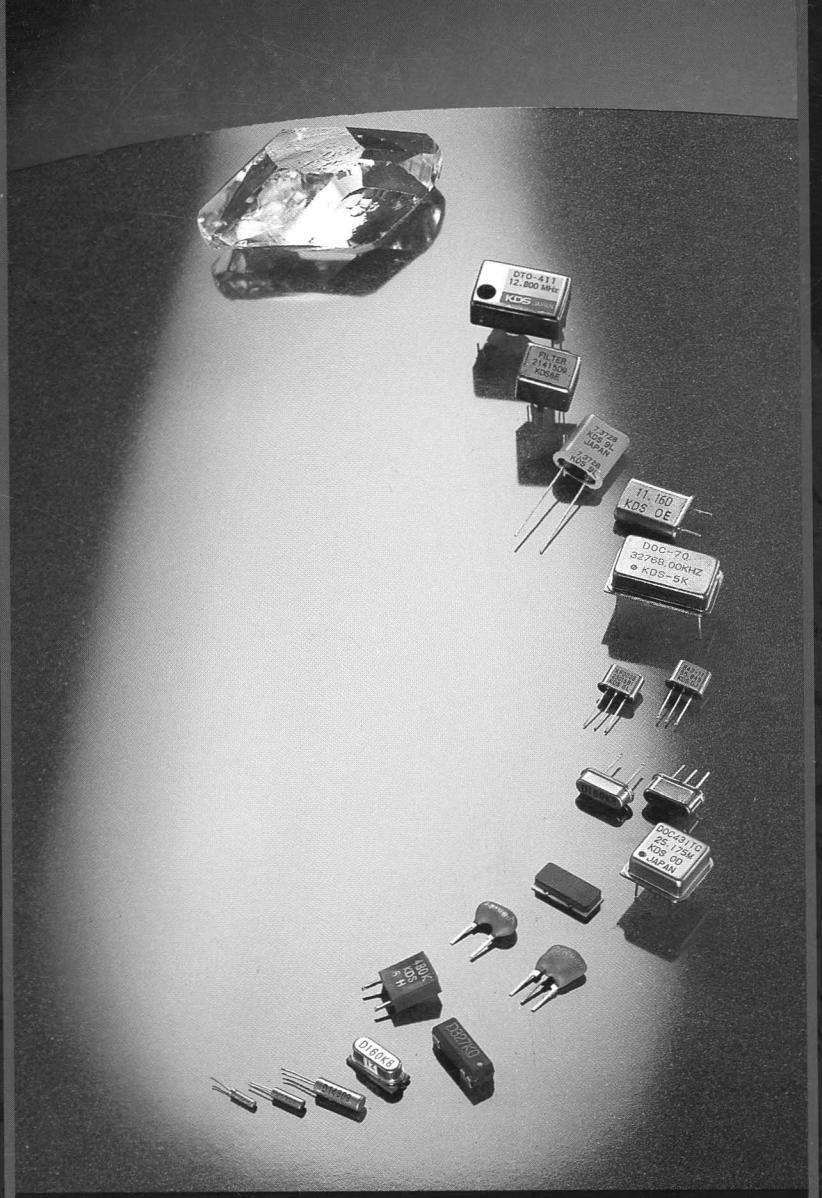


KDS AMERICA

USER'S GUIDE

Quartz Crystals
Crystal Clock Oscillators
Quartz Filters
Ceramic Resonators

KDS—America. Serving the U.S. from two strategically located corporate offices and a national network of distributors, KDS provides dependable product availability and outstanding customer service.

KDS—America is proud of our progress because it has been driven by a strong desire to serve you, our customers. A central focus at KDS is to develop and to strengthen business relationships with innovative OEM's and other centers of technological excellence.

Ongoing communication enables us to provide cost-effective solutions to product development needs and helps reduce time-to-market for our customers. Because these synergistic partnerships have proven successful, KDS has been chosen as a sole source or a primary source to many of the world's leading electronic OEM's.

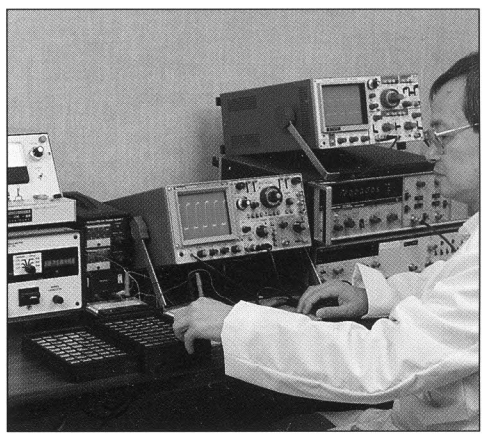
Our objective is to continue to provide excellence in products and worldwide technology support at competitive prices. Because of our broad product line, experience and commitment to the global marketplace, companies from the smallest to the world's largest count on KDS for all their frequency management projects. We welcome the opportunity to serve you and hope you too, will make your One Safe Source, KDS – America.

Over 30 Years of Leadership

KDS was founded in Kobe, Japan in 1959. Known then as Daiwa Shinku Kogyosho,the company produced vacuum tubes and crystal resonator base materials. Soon after its incorporation in 1963, the company began integrated full-scale production of crystal resonators.

During the early 1970's, the company expanded its capabilities by building its first cultured crystal manufacturing plant. During the next ten years, two additional plants with more than 60 super efficient autoclaves were added thus making the Daishinku Corporation the world's largest manufacturer of cultured crystals. As demand for crystal resonators and other crystal products continued to grow, three additional automated factories were subsequently added to produce finished crystal products.

Today, each plant specializes in various phases of quartz product production. All steps in the production process are integrated so the quality of the finished component is assured. Because of our leadership in mass production and innovation, KDS capacity now fills major, worldwide demand.



Research and Quality Assurance

Using original KDS materials and developments, we have contributed significantly to advances in the expanding electronics industry. Our dedication to research and new product development was underscored when we built the independent Central Research Laboratories in Kakogawa City, Japan. This addition allows us to streamline our development of new products and new product applications.

In addition to tuning fork type crystals for wrist watches and clocks, KDS supplies a wide variety of advanced crystal electronic products to manufacturers in Switzerland, Germany and other European countries as well as the USA, Japan and other Asian nations. Our crystal applied products are vital components of color TV's, VCR's, audio equipment, cameras, microwave ovens, other household appliances, mobile and cellular telephones, computers, fax machines, and other personal and data communication devices.

Each factory has implemented exacting quality assurance standards to assure consistent production of superior products. Our employees are constantly involved in training and experience with different specialty fields. Combined with input from our worldwide sales force, this interaction has become the catalyst for many new product developments and refinements. The manufacturing process takes place in a clean environment and we utilize the latest in automated equipment including several hundred assembly robots. Each step along the way, equipment and processes undergo rigorous inspection and testing. Quality assurance is a part of every job, every day, so you will be satisfied with your KDS components every time.

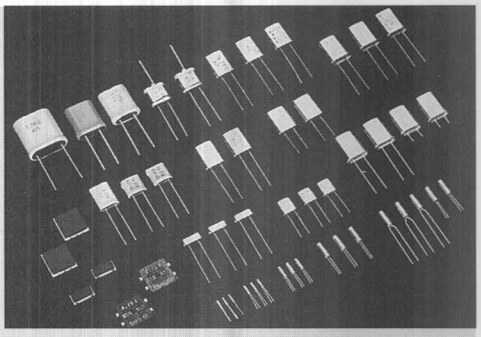
Call or write for a KDS quality control manual.

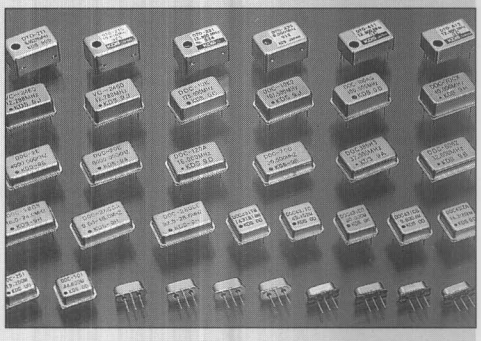
This catalog contains valuable information on our broad selection of quartz crystals and crystal-applied products. In addition to the items shown in this User's Guide, we offer special product development and can design components to meet your specifications.

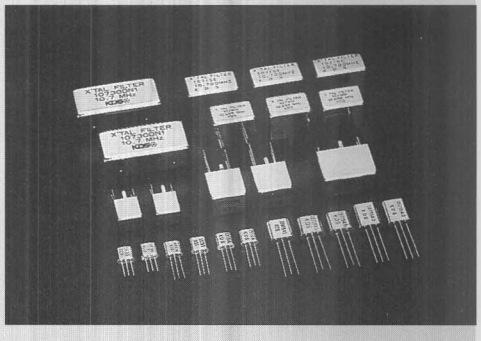
KDS makes no representation that the use or interconnection of the products described herein will not infringe on existing or future patent rights, nor do the descriptions contained herein imply the granting of licenses to make, use or sell equipment contructed in accordance therewith.

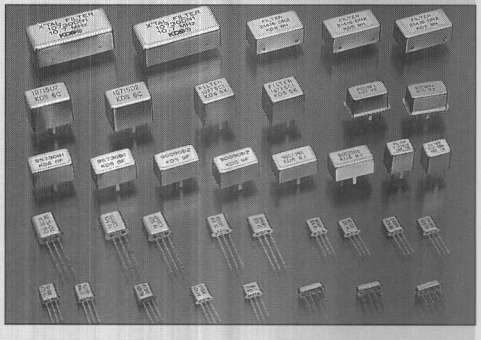
Information in this catalog is typical and should not be construed as a specification for every unit of that basic type. If you do not find the components you need listed here, please call KDS–America.

Table of Contents









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Crystals – Terms and Definitions

The following terms are commonly used in discussing quartz crystals and crystal applied products as described in this catalog.

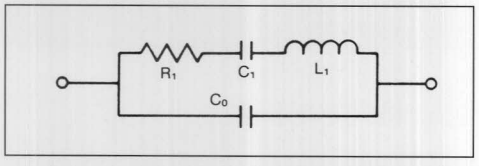
Crystal Quartz: Writings which date to the early Roman Empire describe mysterious clear rocks which were discovered high in the Alps. Originally thought to be ice fossils, these colorless transparent natural quartz crystals were later found to be formed from silicon and oxygen under high pressure and temperature. Because there are few natural quartz crystals formed, a process of growing cultured quartz of high quality and reliability was developed using autoclaves. Most crystal quartz now used is cultured so that purity and quality can be controlled. Today, there are infinite possibilities for cultured crystals and crystal applied products.

Piezoelectric Effect: Pierre and Jacques Currie discovered that pressure applied on a quartz crystal generated voltage and when voltage is applied across a crystal, mechanical motion or vibration is produced. From these beginnings in 1880, the frequency characteristics of crystals have been determined to be dependent on various factors:

a) The operating circuit.
b) The ambient temperature.
c) The cut or plane of the crystal sample with relation to the crystal line axes of the quartz.
d) The dimensions of the sample.

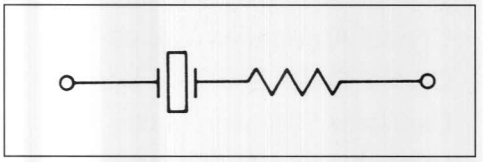
Equivalent Circuit: The rather complex electro-mechanical function of the piezoelectric effect can be illustrated as a simple equivalent circuit (fig. 1). When a crystal operates near its fundamental resonate frequency, the static or shunt capacitance (C_o) is the sum of the capacitance between electrodes and the capacitances added by the leads and mounting structure. L_1, C_1, and R_1 are known as the motional arm of the circuit. L_1 is the the motional inductance, C_1 represents the motional capacitance of the quartz and R_1 represents the the equivalent motional arm resistance or series resistance.

(fig. 1) Equivalent Circuit

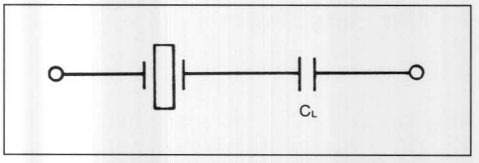


Series Resonance: Measurement or correlation of frequency is simple in crystals operating at series resonance (fig.2). Series resonance appears resistive in the circuit and impedance at **fs** is near zero. All crystals are manufactured at series resonance unless load capacitance is specified.

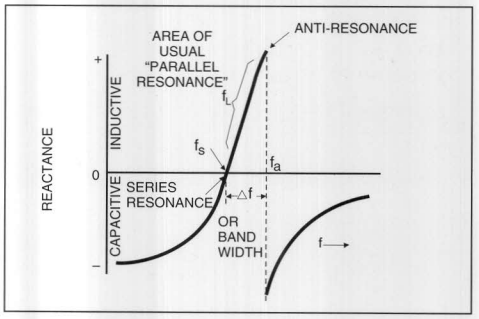
(fig. 2) Series Resonance



Parallel Resonance: When a crystal is operating at parallel resonance (**fL**) it will look inductive in a circuit (fig. 3). Crystal frequency will vary depending upon the value of load capacitance (C_L). Frequency will increase as load capacitance decreases. The Load capacitance is the dynamic capacitance of the total circuit as measured or computed across the crystal terminals. In parallel circuit designs, the load capacitance should be selected to operate the crystal at a stable point on the **fs-fa*** reactance curve as close to **fs** as possible. Always specify the load capacitance if the crystal will be operated in the parallel mode. Typical values are 20pf, 30pf and 32pf.
* (fa = anti-resonance)

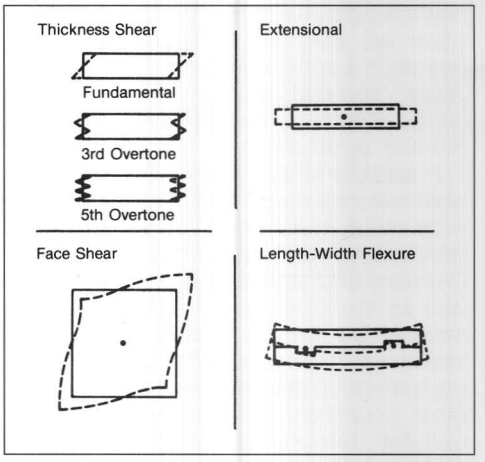


(fig. 3A) Resistance vs Frequency



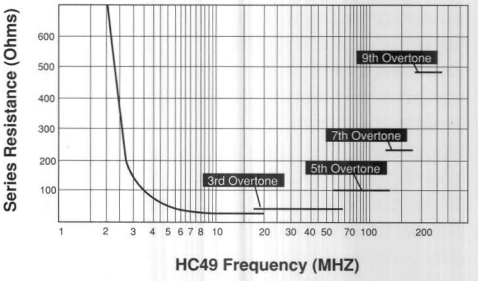
Drive Level: Power dissipated through a crystal in an operating circuit is expressed as the drive level. A drive level (measured in microwatts) which is too high or too low can cause undesirable effects. Drive levels vary from tenths of a milliwatt for low frequency crystals to 10μW for high frequency crystals. If the level is too high, it can cause the oscillator frequency to change, cause a fracture of the quartz element or lead to a permanent shift in frequency output. If thedrive level is too low, it can prevent oscillator function completely. Generally, the drive level should be kept at the specified level required for high stability and adequate oscillator output.

(fig. 4) Modes of Vibration



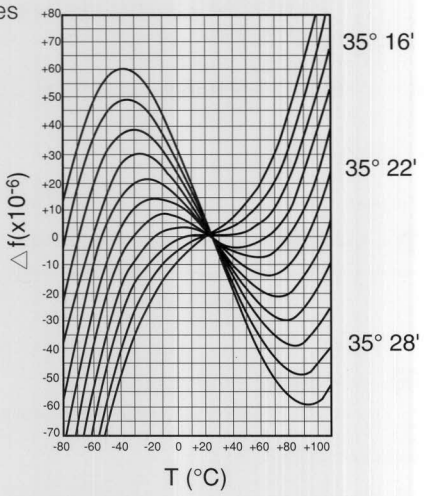
Modes of Vibration: Extensional, shear and flexure are the three general modes of vibration used for commercial applications. Both fundamental and overtone frequencies are possible within each of these modes.

(fig. 5) Maximum Series Resistance (R_1) vs. Frequency



Crystal Cuts: The piezoelectric properties of the quartz element are dependent on the plane or "cut" of the element in relation to the optical axes of the quartz bar. The AT-cut (fig. 6) is the most commonly used quartz crystal and is cut at about a 35° angle to the optical axis. The resulting quartz crystal element is a piezoelectric resonator with ideal properties which make it highly accurate and stable. The resonant frequency range of the AT-cut is from 800KHz to over 300MHz. including overtones. Lower and higher frequencies can be achieved by utilizing frequency multipliers or frequency dividers. The AT cut exhibits small variation in frequency with temperature change. The reference angle of 35° to the axis is the center of symmetry and is the reference for our AT-cut crystal specifications.

(fig. 6) AT Cut Frequency/Temperature Curves



Overtone Crystals: A crystal can vibrate at many frequencies depending on the plane of cut, physical properties and geometry of the crystal blank. The lowest frequency is called fundamental and is the the usual mode of output. Higher frequencies such as 3rd, 5th, 7th and 9th harmonics (overtones) can be achieved by slight adjustments to the circuits (fig 5). Overtone crystals are specially processed to maintain plane parallelism and surface finish in order to enhance performance at the overtone frequency.

Spurious Modes: Vibration at frequencies not related to the fundamental or overtone frequencies are known as spurious modes. These undesired frequencies are inherent in every crystal resonator but are minimized by design and manufacturing processes. Spurious responses can be further reduced by assuring that the oscillator feedback circuit is at its highest gain at the desired operating frequency.

Frequency Tolerance: The frequency tolerance is the maximum allowable deviation from normal frequency (±) at a specified temperature. It is normally specified in parts per million (ppm) or % of nominal frequency.

Stability Tolerance: The maximum allowable deviation from nominal frequency over a specified temperature range is the stability tolerance or temperature coefficient. This factor is dependent upon the angle of cut, the width/length ratio, the mode of vibration and harmonics. It is normally expressed in terms of ppm or % of nominal frequency.

Aging: Quartz crystal aging refers to the permanent change in operating frequency which occurs over time. The rate of change in frequency is fastest during the first 45 days of operation. Although many factors affect aging, drive level, internal contamination, crystal surface change, ambient temperature, wire fatigue and frictional wear are the most common. Proper circuit design will greatly reduce nearly all these problems. Design considerations should include low operating temperatures, minimum drive level and static pre-aging.

Pullability: A parallel resonant crystal will exhibit frequency change known as pullability. Pullability is a function of load capacitance and is important to the circuit designer when several operating frequencies are desired from the same crystal and is achieved by means of switching load values.

Shock Characteristics: Typical shocks in the field produce complex shock pulses which can have a detrimental effect on crystal products. There are many different types of shock impulses such as half sine, haversine, square and sawtooth and complex combinations. Do not over specify since the elastic properties of the materials and the degree of isolation afforded by the equipment will decrease the destructive potential of a shock. Crystals are designed to handle normal shock in handling. However, since crystals are relatively delicate, they should be isolated from equipment to minimize shock damage.

Field Vibration: Although there are two basic types of vibration, periodic and random, typical vibration in the field produces complex waves of motion which can affect the output of quartz crystals. Most vibration-induced failures occur as a direct result of mechanically amplified resonances. Much higher acceleration levels are reached by resonant areas with resultant higher levels of destructive potential. All influencing factors should be thoroughly evaluated using a prototype. Structural system, location of components, mounting, and encapsulation should all be considered in efforts to maximize design stability. Crystals are designed to withstand normal vibration in handling and added ruggedizing may detract from desirable characteristics such as stability tolerance or aging.

Equations:	Legend:
f_S= (Series) Frequency = $\frac{1}{2\pi\sqrt{L_1 C_1}}$	f – Nominal frequency in Hz
$f_L - f_S = \Delta f = \frac{C_1}{2(C_0 + C_L)}$	f_S – Series resonant frequency Hz
L_1= Motional Inductance = $\frac{1}{4\pi^2 f_S^2 C_1}$	f_L – Anti-resonant frequency in Hz
C_1 = Motional capacitance = $2(C_0 + C_L)\Delta f$	L – Inductance in Henrys
Q = Quality Factor = $\frac{2\pi \bullet f_S \bullet L_1}{R_1}$	C_1 – Motional capacitance in farads
R_1 = Series Resistance = $\frac{2\pi \bullet f_S \bullet L_1}{Q}$	C_0 – Static capacitance in farads
C_0 = Shunt Capacitance = $\frac{C_1}{2 \bullet \Delta F} - C_L$	C_L – Load capacitance in farads
C_L = Load Capacitance = $\frac{C_1}{2 \bullet \Delta F} - C_0$	R_1 – Series resistance Ω
P_L = Pullability = $\frac{C_1 \bullet 10^6}{2(C_0 + C_L)^2}$	Q – Quality factor
	P_L – Pullability (ppm/pf)

Soldering Characteristics: KDS products may be soldered to P.C.B.'s and substrates using a variety of methods:

- Wave or Dual Wave
- Hot Air or Convection Flow
- Vapor Phase Reflow
- Infrared Reflow
- Bubble Solder Immersion
- Other (Laser, etc.)

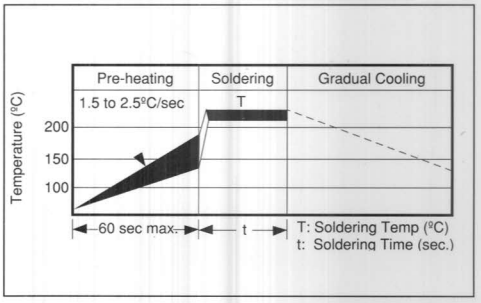
Due to natural characteristics of materials, some of our products exhibit a poor ability to withstand heat shock. When exposed to extreme temperatures, Tin (Sn) plating from the inside of the enclosure can reach its melting point and deposit solder on the quartz element thus causing the component to oscillate at a lower frequency or to fail completely. In other instances, the solder contact to the crystal element may degrade resulting in an open circuit. These effects can be avoided by preheating the components and board and following the recommended soldering process time/temperature profile.

Process Time/Temperature Profile*:

Product	Soldering Temp. T (C°)	Soldering Time t (sec.)
HC-49, AT-49 UM-1, SMD-49	240-250°	20 sec. max.
AT-38,DMX-38 DT-26, DT-38	240-250°	10 sec. max.
DT-381	Infrared Reflow 215-225°	
All Clock Oscillators	240-250°	20 sec. max.

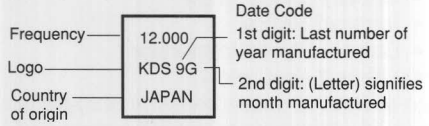
*Note: It is important to check with your KDS factory representative before subjecting any crystal components to extreme environmental conditions.

(fig. 7) Vapor Phase, Wave, Infrared Reflow Soldering



KDS Crystal Part Number Guide

The KDS Crystal Part Number is composed of three major elements (1) Crystal Package Type, (2) The frequency of operation and (3) the calibration method. If the crystal is calibrated in series, the part number will end with an "S". If the crystal has been calibrated in parallel resonance, the package number will be followed by the value of (C_L) Load Capacitance in picofarads (pf).



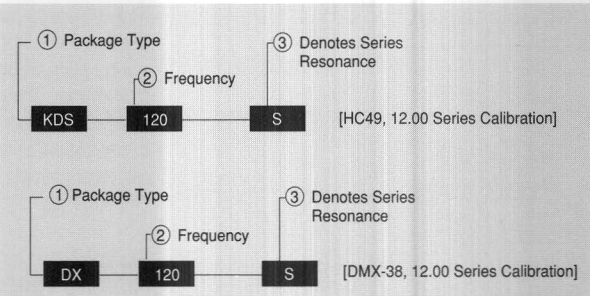
Date Code: All KDS products carry an easily identified date code which utilizes a single digit to identify the year and a letter to signify the month of manufacture. KDS packages also include the company logo and country of origin (Japan or Indonesia).

NOTE: All AT-49 marking is on top of the enclosure due to size restrictions. All tubular components have KDS and date code as their markings.

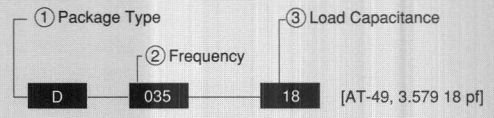
Month Code Chart

Designation	Month
A	January
B	February
C	March
D	April
E	May
F	June
G	July
H	August
J	September
K	October
L	November
M	December

When Calibrated in Series



When Calibrated in Parallel



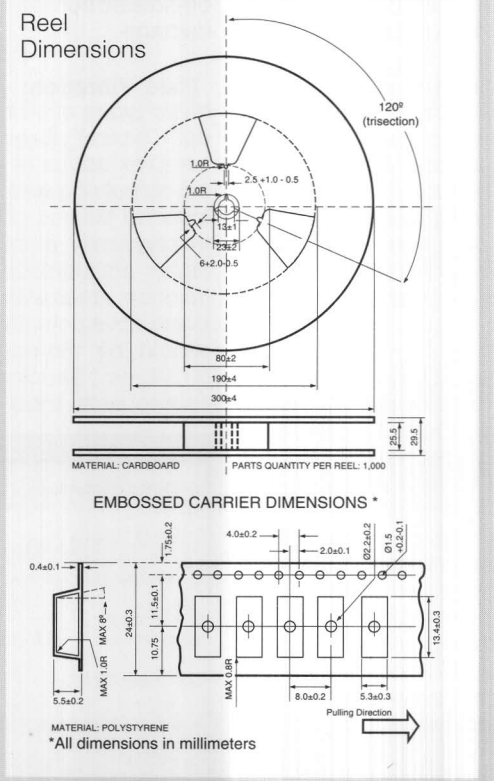
① Package Type: See Selection Guide
② Frequency in MHz
③ Load Capacitance: Specified by Customer in Picofarads (pf)

When a third lead or hold down pin is required, "3L" is added as a suffix to the part number shown here.

KDS-120-S 3L

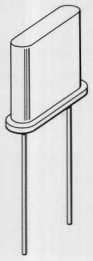
KDS-035-18 3L

Pocket Tape & Reel Dimension and Embossed Carrier Dimensions (For SMD-49, DMX-38)

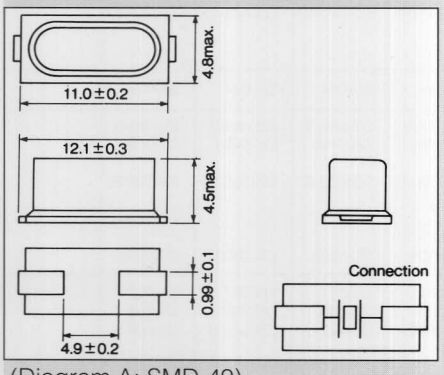


All specifications subject to change without notice.
Most KDS products are available in tubes or tape/reel to facilitate automatic assembly. Contact your KDS sales representative to discuss leaded tape/reel specifications and anti-static tubes for leaded crystals and oscillators.

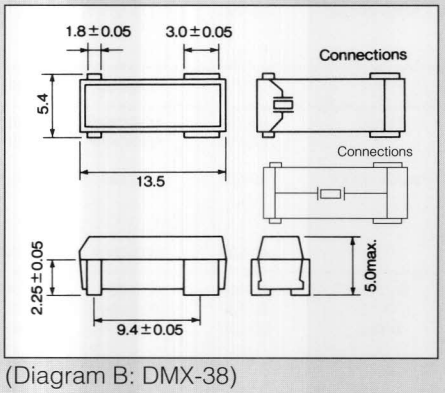
The crystal enclosures listed below represent the most commonly used types. Special configurations are also available.

										
Frequency range	1.8432-200.0 MHz	3.579545-50.000 MHz	3.579545-50.000 MHz	3.579545-50.000 MHz (surface mounted)	3.579545-50.000 MHz (surface mounted)	32.768KHz (surface mounted)	3.579545-25.000 MHz * NOTE (surface mounted)	8.00-200.0 MHz	32.768 KHz	15.0-150KHz (DT-381) 28-80KHz (DT-261)
KDS Type	HC-49	AT-49	AT-38	SMD-49	DMX-38	DMX-26	SX-1	UM-1	DT-26 DT-38 DT-14	DT-261 DT-381
Maximum Dimensions in Millimeters Unless Noted										
Package Height	13.5	3.5	8.8	4.5	5.0	3.0	2.5	8.0	6.0 8.3 5.0	6.0 8.3
Package Width	11.5	11.5	Ø3.1	12.1±0.3	13.5	9.0	11.8	8.0	Ø2.0 Ø3.0 Ø1.4	Ø2.0 Ø3.0
Pkg Thickness	5.0	5.0	–	4.8	5.4	3.4	5.5	3.5	–	–
Pin Length (min.)	20±1.0	12.7±1.0	10.0±1.0	See Diagram A	See Diagram B	See Diagram D	See Diagram C	12.5±1	5.0 min. 10 ±1.0 5.0 min.	5.0 min. 10 ±1.0
Pin Diameter	.430	.430	.300	See Diagram A	See Diagram B	See Diagram D	See Diagram C	.35±0.05	0.28±0.05 0.35±0.07 0.15±0.05	0.28±0.05 0.35±0.07
Pin or Pad Space 'X' Center to Center	4.88±0.2	4.88±0.2	1.1±0.2	See Diagram A	See Diagram B	See Diagram D	See Diagram C	3.75±0.2	0.7±0.2 1.1±0.2 0.4±0.1	0.7±0.2 1.1±0.2

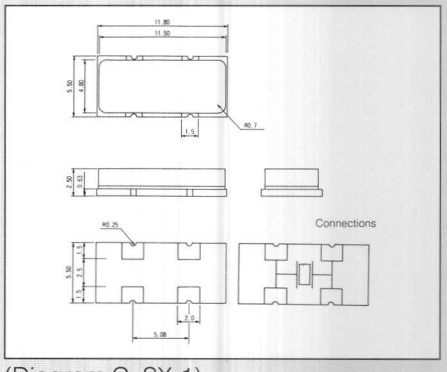
*NOTE: Up to 50.0 MHz under development.



(Diagram A: SMD-49)



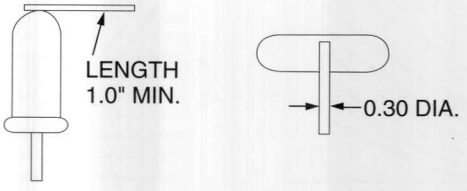
(Diagram B: DMX-38)

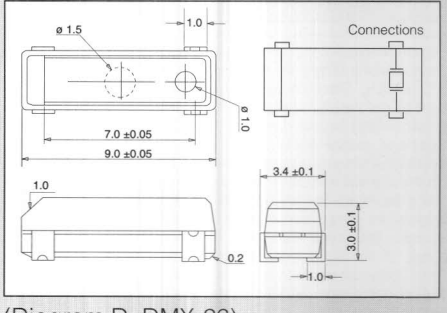


(Diagram C: SX-1)

Special Hold Down Grounding Pin

To specify hold-down pin, add the suffix "-3L" to the KDS type number. Example KDS 035-18-3L





(Diagram D: DMX-26)

Crystals – Microprocessor Application Tables

KDS quartz crystals provide high reliability and long-term stability which make them ideal for microprocesor applications. Each type features low series resistance, precision frequency selection and stable frequency tolerance within the specified temperature range.

The chart below lists some of the most common microprocessor applications along with corresponding frequencies. The KDS microprocessor crystals exhibiting those frequencies are shown for each sample application.

All crystals are resistance welded. The HC-49 and UM-1 types are available with optional third lead or hold-down pin to facilitate mounting parallel to the board for maximum component density. Other crystals with similar characteristics are also available in surface mount and reduced height packages.

Frequency (MHz)	Sample Microprocessor Applications	Calibrated at Series or Parallel	Range of Effective Series Resistance (OHMS)	KDS Type Identification (Pkg No.) HC-49	AT-49	AT-38	SMD-49	DMX-38	SX-1	DT-26, 38, 14
32.768 (KHz)	DS1215, 1285-24, 1285Q-28, CDP6805, 1879 6811, 6818, MC68HC68, 146805. 6146818, SM512 563A, LH0801, LR4810	Parallel @12.5pf	50,000							DT-26, 38, 14 (See figures 1, 2 and 3 below.)
1.8432	MC14411, 146818, 6802, 6551, CDP6853, HD6406 1802, HC68T1	Parallel @13pf	600	KDS-018-13						Markings are KDS Datecode, pg 4.
2.0	F-8, 1610, 2650, 3850, 3851, 3852, 3853, 3856, 3870, 6102, 6500, 6800, 6801, 6802, 6809, 6846 6875, INS 8060, INS 8900, SCN2652, 268652	Parallel @20pf	600	KDS-020-20						
2.097152	MM 5378, MM 5379, 1802, MC68HC68T1, CDP1879 MC 6802, NSC 800	Parallel @20pf	450	KDS-0209-20						See Selection 15.0 - 150KHz, pg. 5.
2.4576	2920, IM 4702, 4712, 6100, TMS 9980, 9981 MC 6802, 34702, Baud Rate Generator, 34702, 6802 HD6406	Parallel @32pf	350	KDS-024-32						
3.0	MSC-48, MC 6802, 3870, 8021, 8035, 8041, 8048 8080, 8085A, 8741, 8742, 8784, 9900, 1802, MC548 SPB0400, HD6406	Series	350	KDS-030-S						
3.2768	CP1600, ICM 7205, MC 6802, NSC 800, IM 6100	Parallel @18pf	150	KDS-032-18						
3.579545	1372, 3870, 6801, 6802, 6803, 6808, 68701, 3872 3873, 3874, 3876, 6102, 8020, 8021, 8022, 8035, 8748 PPS4, PPS8, uPD762C, 1802, MM5369, CCU2030 2050, 2070, MAA4000, 4030, R650X, 651X	Parallel @18pf	150-200	KDS-035-18	D-035-18	AT-035-18	DS-035-18	DX-035-18	SX-035-18	
3.6864	SCN2641, 2681, 2691, 2692, 2698, 68681, 68692	* *	90-200	KDS-036	D-036	AT-036	DS-036	DX-036	SX-036	
4.0	3870, 6801, 6802, 6803, 6805, 6808, 6809, 68000, 68701 68705, 146805, 8060, 8070, 8072, TMS1200, TMS9940 Z80, Z8000, SC-MP-11, 8X300, PACE, MSC-40, 6100 HD 46801, 46802, EA9002, 4004, 4040, 4048, 4201 R6500, 65/11E, 6501, 6502, 6503, 6504, 6505, 6506 6507, 6511, 6518, 6804P, 6805, 68HC05, 6875, 68(7)O5R/U, 68701, SCN68681, 68692, 2641, 2681, 2691 2692, 2698, CCU3000, MC6804, 68(7)05R/U, 68HC05, 6875, 68701, CDP1802, HS-80C85RH	Series	90-180	KDS-040-S	D-040-S	AT-040-S	DS-040-S	DX-040-S	SX-040-S	
4.194304	ICM7038A, 7049, 7213, uPD7507, 7508, 7516, 7519, 75104, 75106, 75108, CDP6818, MC68HC68T1, 1802 146818, UM6502, 6507, 6512	Parallel @12pf	60-150	KDS-041-12	D-041-12	AT-041-12	DS-041-12	DX-041-12	SX-041-12	
4.433619	SIG2650, MC68701, European Colorburst	* *	* *	KDS-044	D-044	AT-044	DS-044	DX-044	SX-044	
4.9152	NSC800, Z80A, COM5026, 5046, 1802, 1804, SCN2661	Series	60-120	KDS-049-S	D-049-S	AT-049-S	DS-049-S	DX-049-S	SX-049-S	
4.9562	4004, 4040, 4045, 4048, 4201	* *	60-120	KDS-0495	D-0495	AT-0495	DS-0495	DX-0495	SX-0495	
5.0	Z80, 8085, 8086, 8088, CP1600A, 6801, 6803, 68701 146805, TMS9940, TMS9985, COP 1802, 1803 1804, IM6100A, IAPX88, 1805, 1806, 68701U4 uPD80C42G, 70320, 70322, TMS7000, 7020, 7742, 70C00, 70C20, 70C40	Parallel @20pf	60-120	KDS-050-20	D-050-20	AT-050-20	DS-050-20	DX-050-20	SX-050-20	
5.0688	8X300, COM5016, 5036, SCN2651, 2661C	* *	60-100	KDS-0508	D-0508	AT-0508	DS-0508	DX-0508	SX-0508	
5.76	uPB2819C	* *	60-100	KDS-057	D-057	AT-057	DS-057	DX-057	SX-057	
5.9904	8048, 8748	* *	60-100	KDS-059	D-059	AT-059	DS-059	DX-059	SX-059	
6.0	8035, 8041, 8048, 8085, 8741, 8749, 6801, 6802, 6803 6808, 6809, 68000, 68701, TMS 9995, MCS-48, CP1600 1802, 8049, 8747, 6500/1, 68A09, uPD48, uPD8741AD, 78310, 78312, 80335, 80C48, 72030, SC96, TMS70C02 70C42, Z80180	Series	60-100	KDS-060-S	D-060-S	AT-060-S	DS-060-S	DX-060-S	SX-060-S	

This is the deviation in ppm of the crystal over a temperature range as referenced to the 25°C reading. Decreasing tolerances of the angle of cut result in greater precision but correspondingly higher cost of manufacture. In general, temperature ranges should be specified which are symmetrical about 25°C with the highest temperature being the controlling factor for the lowest. The wider the temperature range and the tighter stability required, the more expensive will be the crystal. In addition, for each temperature range, there will exist an absolute minimum value of achievable frequency stability. Not all specifications can be met over all desired temperature ranges. (See chart at right.)

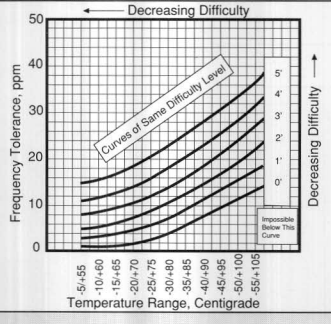


Fig. 1) Frequency Tolerance vs Temperature

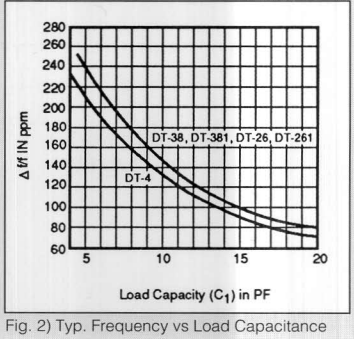


Fig. 2) Typ. Frequency vs Load Capacitance

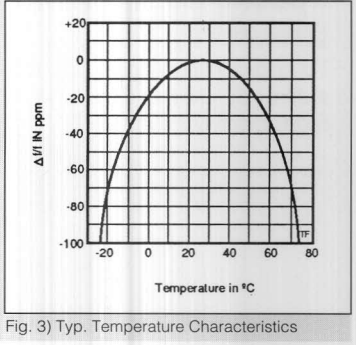


Fig. 3) Typ. Temperature Characteristics

Frequency (MHz)	Sample Microprocessor Applications	Calibrated at Series or Parallel	Maximum Effective Series Resistance (OHMS)	KDS Type Identification (Pkg No.)						
				HC-49	AT-49	AT-38	SMD-49	DMX-38	SX-1	UM-1
6.144	8085,8089, MSC-85, 1802, 8748, CP1600	Parallel @30pf	60-100	KDS-061-30	D-061-30	AT-061-30	DS-061-30	DX-061-30	SX-061-30	
6.25	uPD78C05A, 78C06A	* *	60-100	KDS-062-30	D-062-30	AT-062-30	DS-062-30	DX-062-30	SX-062-30	
6.5536	7208, ICM 7045, ICM 7207, ICM 7034	Parallel @20pf	60-100	KDS--065-20	D-065-20	AT-065-20	DS-065-20	DX-065-20	SX-065-20	
7.15909	1802	* *	35-80	KDS-071-20	D-071-20	AT-071-20	DS-071-20	DX-071-20	SX-071-20	
7.3728	Various	* *	35-80	KDS-073-20	D-073-20	AT-073-20	DS-073-20	DX-073-20	SX-073-20	
8.0	6801, 6802, 6803, 6808, 6809, 68000. 68701, 1804, 1805, Z8, Z8000, 8086, 8088, 8X300, CP1600,IM6100, TMS7002 7042, 9980, MC6875, HD68B09, 6303,63A03,63B03, 6305, 63A05, 63B05, uPD80C42C, 71011, R65C10,6500 LH0801A, 0082, 8X330, PCB5010, CPB5011, UM8035, 8039, 8048, 8048, 8049, 8600, 8601, 8603, 8671 8681, Z80180, 84C90	Series	35-80	KDS-080-S	D-080-S	AT-080-S	DS-080-S	DX-080-S	SX-080-S	
8.064	R68560, 68561	* *	35-80	KDS-086-18	D-086-18	AT-086-18	DS-086-18	DX-086-18	SX-086-18	
9.8304	Various	Series	35-80	KDS-098-S	D-098-S	AT-098-S	DS-098-S	DX-098-S	SX-098-S	
10.0	AM2901, AM29116, 8086, 8088, MSC 85, 2920, 9400, 9440, NS 16000, 8080, 8008, 8224, 8085A, 8085AH, uPD7807, 7808, 7809, 7810, 7811, 78PG11, 82284 68000, 68B68430, SC8X305, 80C286	Series	35-80	KDS-100-S	D-100-S	AT-100-S	DS-100-S	DX-100-S	SX-100-S	UM-100-S
10.738635	TMC9918	* *	35-70	KDS-107-S	D-107-S	AT-107-S	DS-107-S	DX-107-S	SX-107-S	UM-107-S
11.0	8039, 8040, 8049, 8050, MSC 48, 6804, 8749, 8041, 8048	Series	35-70	KDS-110-S	D-110-S	AT-110-S	DS-110-S	DX-110-S	SX-110-S	UM-110-S
12.0	8031, 8051, 8751, 2920,MSC 86, 65C02, 65C102, 65C112 68B68, 80186, 80188, 803C1, 80C39, 80C49, 80C40, 80C50, 80C51, 80515, 80535, 80C521, 80C321, 8032. 8052, 80532, 80515, 80535, 86C08, 86C10, 86C11, 86C20, 86C21, 86E21, 8751, 8753, HD6306, 63A03, 63B03, 6309, 63B09, 63C09, uPD7810, 7811, 78C10 78C14, 78PG11, 7807, 7808, 7809, SC96, Z8611	Series	35-70	KDS-120-S	D-120-S	AT-120-S	DS-120-S	DX-120-S	SX-120-S	UM-120-S
14.31818	6883, 8008, 8080, 8224, SN74L2783,	* *	35-60	KDS-143-S	D-143-S	AT-143-S	DS-143-S	DX-143-S	SX-143-S	UM-143-S
14.7456	SCN68562	* *	35-50	KDS-147-S	D-147-S	AT-147-S	DS-147-S	DX-147-S	SX-147-S	UM-147-S
15.0	8008, 8031, 8053, 8080, 8086, 8224, 8284	* *	25-50	KDS-150-S	D-150-S	AT-150-S	DS-150-S	DX-150-S	SX-150-S	UM-150-S
16.0	80C286, 80186-3, 80188-3, 82284, 80C31, 80C51, HD6409, 6883, uPD70208, 70216, R65C02, 65C102, 65C112, SAB8051, 8031, 68562, Z8681, 8691, 86C08 86C10, 86C11, 86C20, 86C21, 86E21, 68HC000, 68000									
18.0	8080A, 8224, MSC 80, 8008, 8031AH, 8051AH, 8053AH	Series	25-40	KDS-180-S	D-180-S	AT-180-S	DS-180-S	DX-180-S	SX-180-S	UM-180-S
18.432	8080A, 8224, MSC 80, 8008, AM9080, uCOM80	Series	25-40	KDS-184-S	D-184-S	AT-184-S	DS-184-S	DX-184-S	SX-184-S	UM-184-S
19.6608	8008, 8080, 8224, Z80	* *	25-40	KDS-196-S	D-196-S	AT-196-S	DS-196-S	DX-196-S	SX-196-S	UM-196-S
20.0	F9445, MSC 80, AM2900, 8008, 8080A, 8224, Z80, 80186 80188, 82C284, 82284	Series	50-40	KDS-200-S	D-200-S	AT-200-S	DS-200-S	DX-200-S	SX-200-S	UM-200-S
22.0	UDPC1000	* *	50-40	KDS-220-S	D-220-S	AT-220-S	DS-220-S	DX-220-S	SX-220-S	UM-220-S
22.1184	MSC 80, 8008, 8080A, 8224, Z80, AM9080, uCOM80	Series	50-40	KDS-221-S	D-221-S	AT-221-S	DS-221-S	DX-221-S	SX-221-S	UM-221-S
24.0	8086, 8224, 8284, 82C84A, MC68HC11A4, SC80C552 MCS86	* *	50-40	KDS-240-S	D-240-S	AT-240-S	DS-240-S	DX-240-S	SX-240-S	UM-240-S
25.0	68030, 82C84A, 82C85, 82C284	* *	50-40	KDS-250-S	D-250-S	AT-250-S	DS-250-S	DX-250-S	SX-250-S	UM-2505
30.0	8284A-1, 82C84A, 8284B	* *	35-40	KDS-300-S						UM-300-S
32.0	8008, 8080A, 8224, AM9080, TMS8080, uCOM80, HD64180R, SC80C552, 83C552	* *	35-40	KDS-320-S						UM-320-S
36.0	8008, 8080A, 8224, 9070A, 32102	Series-3rd Overtone	35-40	KDS-360-S						UM-360-S
40.0	80386	* *	40-50	KDS-400-S						UM-400-S
48.0	TMS 9900, 9904, 9940, SNLS362, 32102	Series-3rd Overtone	40-50	KDS-480-S						UM-480-S
100.0	IDT49C25	* *	100-120	KDS-100-S						UM-100-S

* * Series or parallel calibration can be specified. Consult Factory

Note: A Suffix number is appended to the KDS type number to denote overtone mode. For example: KDS-400-S-3 is 3rd Overtone.

Exact crystal specifications required may vary according to circuit design. Information is believed to be accurate and not all-inclusive at time of publication.

Frequency tolerance:	±0.005% @ 25º C
Stability tolerance-all types:	±0.005% from -20º C to 70º C (Operating Temperature)
Static Capacitance, C_o all types	7.0pf maximum (except DT26 38, 14)
Storage Temperature all types	-30 to +80º C
Aging (typical)	3 ppm per year

Tighter Tolerance requirements available upon request.

Drive Level, HC-49 (10µW-2µW)

Drive Level AT-49, AT-38, SMD-49, DMX-38, SX-1, UM1 (10µW-50µW)

Recommended Oscillation Circuit (DT38, DT26, DT14)

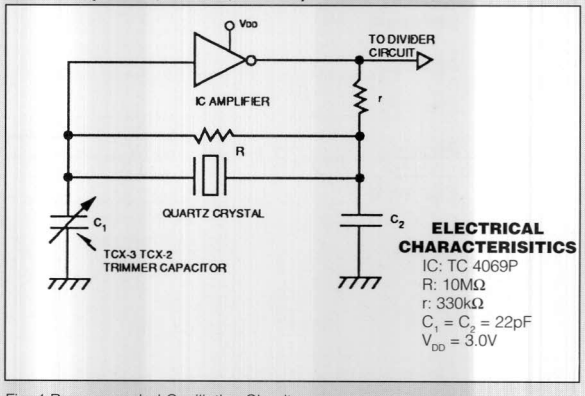


Fig. 1 Recommended Oscillation Circuit

In this circuit, low drive levels with a maximum of 1µW is recommended. If excessive drive is applied, irregular oscillation or quartz element fractures may occur.

Crystal Specification Ordering Guide (Custom Crystals)

Although KDS stocks a wide variety of standard crystals, our customers frequently have special needs for custom applications. Thus, we have developed a capability in providing custom crystals for your specific requirements. If you do not find the crystal required after reviewing this catalog, please complete the following form, outlining your specific needs and we will gladly supply you with a price and delivery.

Availability and Test Data

A wide variety of KDS crystals are available for immediate delivery. Quantities in stock and delivery schedules will vary by product, so ask your KDS representative for details on specific part numbers.

CHARACTERISTICS		
ENVIRONMENTAL		
TEST	CONDITION	* RATING
Storage Temperature	-30°C to +80°C	–
Shock75cm Resistance (Drop)	Drop on oak block three times	After one hour at room conditions (25°C, 60-70% R.H.) $\frac{\Delta f}{f_0} < \pm 5$ppm
Vibration	120 minutes each in X, Y and Z axes 10g, 10 to 55Hz	
Resistance to Soldering Heat	Solder-dip terminals no closer than 1.00mm from the case for 5±0.5 sec., 270±5°C solder bath	
Humidity Steady State	500 hours at 65°C 90 to 98% R.H.	
High Temperature Test	500 hours at +85°C	
Temperature Cycling	*10 cycles, 10 min. at -40°C, 10 min. at +85°C	
MECHANICAL		
TEST	CONDITION	* RATING
Solderability	Same as above for 3±0.5 sec. (250 ± 5°C solder bath)	Leads shall be min. 95% covered with fresh solder
Resistance to Solvent	Dip in freon or alcohol 5 minutes	No electrical or mechanical damage
Hermeticity	Helium leak detector	≤3X 10^{-8}atm-cc/sec.
Terminal Strength	0.5kg pull 30 sec. in lead axis. ±90°C bend 1mm min. from seal	No electrical or mechanical damage

(Ref. MIL-STD-883 and MIL-STD-202)

1. Frequency _____ ☐ MHz ☐ KHz
2. Frequency Calibration ☐ Series ☐ Parallel
3. If Parallel, specify load capacitance in picofarads _____ (pf)
4. Holder Type Preferred ☐ HC-49 ☐ AT-49 ☐ AT-38 ☐ SMD-49 ☐ DMX-38
   ☐ SX-1 ☐ UMI ☐ DT-38 ☐ Other, specify
5. Calibration Tolerance at 25°C ± _____ ppm or %
6. Operating Temperature Range _____ °C to _____ °C
7. Frequency Stability Over Operating Temperature Range ± _____ ppm or %
8. Equivalent Series Resistance _____ Ohms Maximum
9. Drive Level _____ mW Maximum
10. Motional Capacitance _____ (pf)
11. Shunt Capacitance _____ (pf) Maximum
12. Resonant Mode ☐ Fundamental ☐ 3RD O.T. ☐ 5TH O.T. ☐ 7th O.T.
13. Other. Any special lead length, lead forming, sleeve, insulator, etc. Describe in detail any special parameters that are essential to the performance of the crystal in your specific circuit.
    _____
    _____
    _____
    _____
14. Delivery Requirements ☐ Immediate ☐ 3 Months ☐ 6 Months ☐ Longer
15. Quotation required by _____
16. Quote on quantities through _____
17. Application is intended for _____
18. Are samples required ☐ No ☐ Yes, If so, by when _____
19. Annual Usage _____
20. Attach engineering drawing, if available.

QUESTIONNAIRE HAS BEEN COMPLETED BY

Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

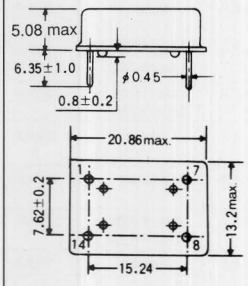
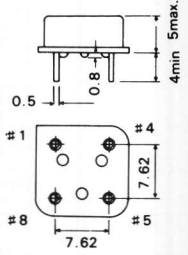
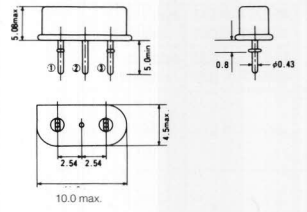
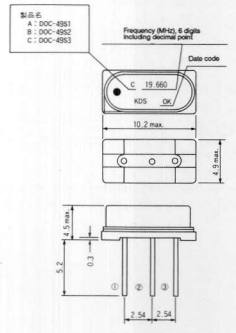
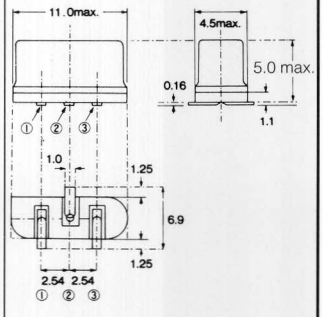
Phone _____ Fax _____

Signature _____ Date _____

(Please reproduce and forward to Engineer's Attention.)

KDS AMERICA
10901 Granada Lane
Overland Park, KS 66211
Phone (913) 491-6825 • FAX (913) 491-6812

KDS AMERICA
17151 Newhope Street, Suite 210
Fountain Valley, CA 92708
Phone (714) 557-7833 • FAX (714) 557-4315

			
PACKAGE DESCRIPTION	14 -PIN DIP Metal Resistance Weld	8-PIN DIP Metal Resistance Weld	3-LEADED SINGLE IN-LINE Metal Resistance Weld
LOGIC OR OSCILLATOR SERIES	DOC-2,20,70,100 TTL DOC 70A, B, ZA, ZB TTL/CMOS/Tri-State DOC-28 TTL/CMOS/Dual Output DOC-386H3 TTL/CMOS (Special) DOC-120C H-CMOS/TTL	DOC-431 CS, CC, TB, TC, DOC-431A, B, ZA, ZB	DOC-49, 492 DOC-49S1, 49S2, 49S3 (Surface Mount) SO-49, SO-492
FREQUENCY RANGE	250.0 KHz – 100.00 MHz (See Data Sheet for Range by Product)	625.0 KHz – 70.00 MHz (See Data Sheet for Range by Product)	156.25 KHz – 50.00 MHz (See Data Sheet for Range by Product)
PACKAGE DIMENSIONS TYPE AVAILABLE	 (Fig. 1)	 (Fig. 2)	 (Fig. 3) DOC-49, DOC-492  (Fig. 4) DOC-49S1, 49S2, 49S3  (Fig. 5) Dimensions SO-49, SO-492

NOTE: Package dimensions are noted on the following pages for DOC-10K, page 19 and DTO Series, page 20.

KDS Crystal Oscillators

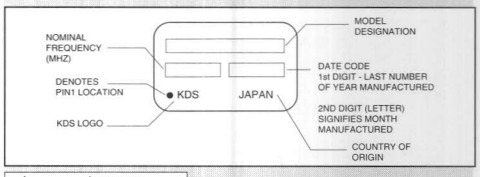
KDS Oscillator products include hybrid oscillators that provide a full range of performance options.

KDS hybrid clock oscillators combine state-of-the-art technology implementing our precision quartz crystal resonators to achieve low cost, high reliability and miniaturization.

Package options include single in-line and PC board mountable packages.

KDS's more than 30 years of experience with piezo electrical technology makes us an industry leader in the development, design and manufacture of oscillators for both standard and custom application.

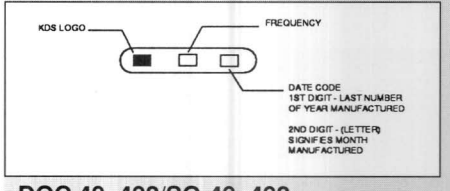
Listed here are typical specifications for KDS oscillators. Complete specifications for each type is listed on the following pages.



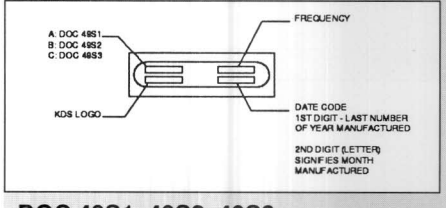
A	January
B	February
C	March
D	April
E	May
F	June
G	July
H	August
J	September
K	October
L	November
M	December

DOC 2, 20, 70, 100
DOC 70, A,B, ZA, ZB
DOC 28, DOC 49
DOC 120C
DOC 431, CS, CC
DOC 431, TB, TC
DOC 431, A, B, ZA, ZB

DOC 49 Series Markings



DOC 49, 492/SO-49, 492



DOC 49S1, 49S2, 49S3

Oscillators – Product Index

ITEM	FREQ.	CASE SIZE	OUTPUT		SYMMETRY(%)		ENABLE-DISABLE	TRI-STATE (Control Pin #1)	FREQ. TOL. (ppm)	"L" (V max.)	"H" (V min.)	Tr & Tf (max.)	CURRENT CONSUMPTION (max.)	CASE HEIGHT
			TTL	CMOS	at 1.4V	at 2.5V								
DOC-2	0.25-4M	14 pin	10TTL	–	40/60	–	–	–	±50,±100	+0.5	+2.4	15nsec	30mA	5.08 +0.8mm
DOC-20	4.01-23.9M	14 pin	10TTL	–	40/60	–	–	–	±50,±100	+0.5 +0.4	+2.4	15ns F<9M 10ns F≥9M	30mA	5.08 +0.8mm
DOC-70	24-70M	14 pin	10TTL	–	40/60	–	–	–	±50, ±100	+0.4 F≥32M +0.5 F<32M	+2.4	10ns F<32M 6ns F≥32M	35mA	5.08 +0.8mm
DOC-70A	1.0-50.5M	14 pin	10TTL	–	45/55	–	–	–	±100	+0.4	+4.5	5nsec	45mA	5.08 +0.8mm
DOC-70B	1.0-50.5M	14 pin	–	50pF	–	45/55	–	–	±100	+0.4	+4.5	10nsec	45mA	5.08 +0.8mm
DOC-70ZA	1.0-50.5M	14 pin	10TTL	–	45/55	–	⇨	open or "H" =oscillate	±100	+0.4	+4.5	5nsec	45mA	5.08 +0.8mm
DOC-70ZB	1.0-50.5M	14 pin	–	50pF	–	45/55	⇨	open or "H" =oscillate	±100	+0.4	+4.5	10nsec	45mA	5.08 +0.8mm
DOC-120C	0.625-25M	14 pin	2TTL	50pF	–	45/55 F<10M 40/60 F≥10M	–	–	±50, ±100	+0.5	+4.5	15nsec	10mA	5.08 +0.8mm
DOC-28CS	9-25M	14 pin	10LS-TTL	50pF	40/60	40/60	–	–	±100	+0.5	+4.0	15nsec	40mA	5.08 +0.8mm
DOC-28CSA	#1, #8 9-25M	14 pin	10TTL	150pF	40/60	40/60	–	–	±100	+0.5	+4.0	10ns (CMOS) 6ns (TTL)	60mA	5.08 +0.8mm
DOC-28CSE	#1, #8 25-40M	14 pin	10LS-TTL	50pF	40/60	40/60	–	–	±100	+0.5	+4.0	15nsec	60mA	5.08 +0.8mm
DOC-28CSF	#1 9-25M #8 25-40M	14 pin	10TTL	120pF	40/60	40/60	–	–	±100	+0.5	+4.0	10ns (CMOS) 6ns (TTL)	60mA	5.08 +0.8mm
DOC-386H3	25-50M	14 pin	For 80386 CPU		–	45/55 at 2.0V	⇨	open or "H" =oscillate	±100	+0.5	+4.5	8nsec	60mA 25-40M 70mA 40-50M	5.08 +0.8mm
DOC-100	50-100M	14 pin	10TTL	–	40/60	–	–	–	±50, ±100	+0.5	+2.4	5nsec	80mA	5.08 +0.8mm
DOC-10K*	70-130M	14 pin	ECL		40-60 at -1.3V		–	–	±50, ±100	-2.03 to -1.54	-1.15 to -0.67	2nsec	60mA	8.20 +0.8mm
DOC-431CS	0.625-25M	8 pin	2TTL	50pF	–	45/55 F<10M 40/60 F≥10M	open or "H" =oscillate	–	±100	+0.5	+4.5	15nsec	10mA	5.0 +0.8mm
DOC-431CC	25-50M	8 pin	5TTL	15pF	–	45/55 F< 10M 40/60 F ≥ 10M	open or "H" =oscillate	–	±100	+0.5	+4.5	6nsec	30mA	5.0 +0.8mm
DOC-431TB	4.0-23.9M	8 pin	10TTL	–	40/60	–	–	–	±100	+0.4	+2.4	15ns F<9M 10ns F>9M	30mA	5.0 +0.8mm
DOC-431TC	24-70M	8 pin	10TTL	–	40/60	–	–	–	±100	+0.4 F<32M +0.5 F≥32M	+2.4	10ns F<32M 6ns F≥32M	40mA	5.0 +0.8mm
DOC-431ZA	1.0-50.5M	8 pin	10TTL	–	45/55	–	⇨	open or "H" =oscillate	±100	+0.4	+4.5	5nsec	45mA	5.0 +0.8mm
DOC-431ZB	1.0-50.5M	8 pin	–	50pF	–	45/55	⇨	open or "H" =oscillate	±100	+0.4	+4.5	10nsec	45mA	5.0 +0.8mm
DOC-49	0.156-20M	SIL	2LS-TTL	15pF	–	45/55 F<10M 40/60 F≥10M	–	–	±50, ±100	+0.5	+4.5	20ns F≥2M 50ns F<2M	5mA	5.08 +0.8mm
DOC-492	0.625-25M	SIL	10LS-TTL	50pF	–	45/55 F<10M 40/60 F≥10M	–	–	±50, ±100	+0.5	+4.5	15nsec	10mA	5.08 +0.8mm
DOC-49S1	0.156-20M	SIL	2LS-TTL	15pF	–	45/55 F<10M 40/60 F≥10M	–	–	±50, ±100	+0.5	+4.5	50ns F<2M 20ns F≥2M	5mA	4.5mm w/insltr
DOC-49S2	20.1-50M	SIL	2LS-TTL	15pF	–	40/60	–	–	±50, ±100	+0.5	+4.5	10nsec	25mA	4.5mm w/insltr
DOC-49S3	1.25-20M	SIL	10LS-TTL	50pF	–	45/55 F<10M 40/60 F≥10M	–	–	±50, ±100	+0.5	+4.5	15nsec	10mA	4.5mm w/insltr

NOTE: DOC 431-ZA, ZB, are tri-state function. Part no. DOC 431 A, B are without tri-state function. All other specifications are the same.

CHARACTERISTICS	
Supply	V:5 (±0.5)V & -5.2V for DOC-10K
Storage Temperature	Up to -55~±125ºC (See each product specification)
Symmetry	1.4V for TTL & 2.4V for CMOS
Case Height	Add 0.8mm for Stand-Off
SIL	Single In-line Package
1TTL	4.0 x LS-TTL
M	MHz
Operating Temp.	0°C - 70°C

SPECIFICATIONS

ITEM \ TYPE		DOC-2	DOC-20	DOC-70	DOC-100AS
Output		TTL			
Frequency Range		0.25~4.0MHz	4.01~23.9MHz	24~70MHz	50~100MHz
Frequency Tolerance*		±50ppm, ±100ppm			
Operating Temperature Range		0~+70°C			
Storage Temperature Range		-55~+125°C			
OUTPUT	"0" Level	+0.5Vmax.	+0.5Vmax. or +0.4V max.	+0.4V max./24.0~32.0MHz +0.5V max./32.1~70.0MHz	+0.5V max
	"1" Level	+2.4V min.			
	Symmetry	60/40~40/60% at 1.4V DC Level			
refer to Fig-1 Fig-3	Rise and Fall Time	15ns max.	15 ns. max/4.01~8.99MHz 10ns max./9.0~23.9MHz	10ns max./24.0~32.0Mhz 6ns. max./32.1~70.0MHz	5ns max.
	Output Load	10 TTL STD GATES			
Power Supply voltage		+5V DC±0.25V	+5V DC ±0.25V	+5V DC ±0.5V	+5V DC ±0.25V
Current consumption		30mA max./+5V 25° C		35mA max./+5V 25°C	80mA max./+5V 25°
Dimensions		Fig-2			

* Inclusive of 25°C tolerance, operating temperature range, input voltage change, load change, aging, shock and vibration.

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

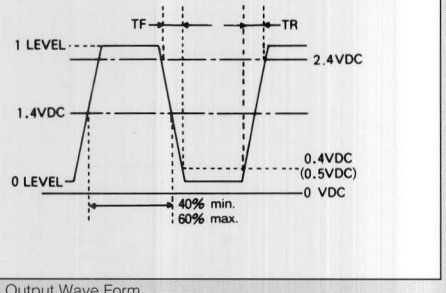


Fig 1) Output Wave Form

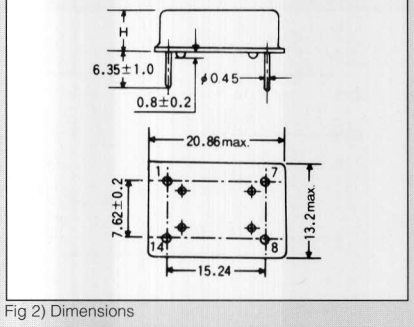


Fig 2) Dimensions

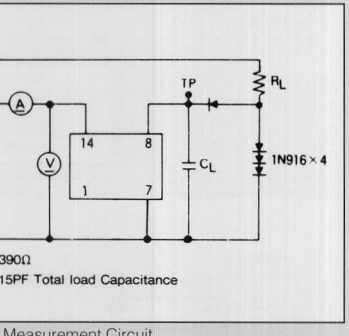


Fig 3) Measurement Circuit

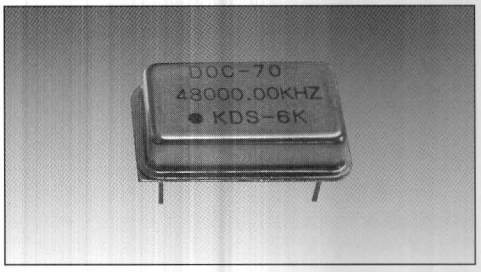
	(H) Height
DOC-2	5.08 max.
DOC-20	5.08 max.
DOC-70	5.08 max.
DOC-100	8.0 max.

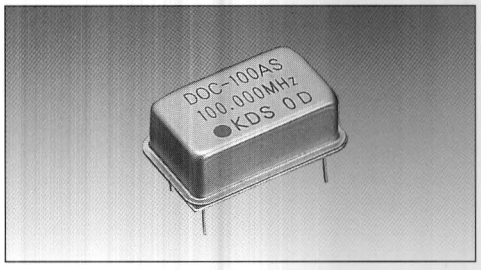
Fig 2A) Case Height

Pin Connections	
#1	NC
#7	GND (CASE GND)
#8	OUTPUT
#14	±5.0V DC

Fig 2B) Pin Connections

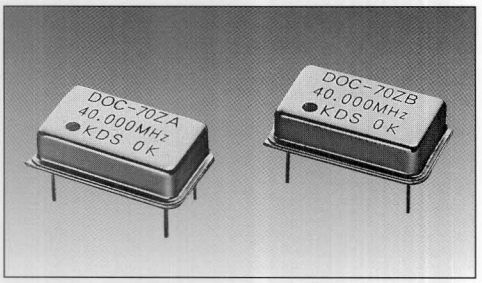
DOC-2
DOC-20
DOC-70
DOC-100





KDS's DOC-2, -20, -70 and -100 hybrid oscillators are compatible with TTL circuitry and offer a dependable, proven design, hermetically-sealed and state-of-the-art technology. With 7-pin case ground, the metal package also provides shielding to minimize radiation, meeting FCC EMI specifications. Insulated stand-offs permit good solderability.

DOC-70Z



The KDS DOC-70Z clock oscillator employs a tri-state buffer for control of the output. Applying a logic '1' voltage level to pin #1 enables the oscillator output and a logic '0' applied to pin #1 disables the output. When disabled, the output goes to the high impedance state. In this state, the oscillator appears to have been removed from the circuit. This tri-state function allows the oscillator to be left on the board when testing the board with automatic test equipment.

SPECIFICATIONS

ITEM		DOC-70ZA	DOC 70ZB
Output		TTL	CMOS
Output Frequency		1.0-50.5MHz	
Frequency Tolerance		±100ppm	
Operating Temperature Range		0°C~70°C	
Storage Temperature Range		–55°C~+125°C	
Operating Voltage		5V±0.5V	
Current Consumption		45mA max.	
OUTPUT	"0" Level	0.4V max.	
	"1" Level	V_{DD} X 0.9 min.	
	Rise and Fall Time	5nsec max. (TTL level)	10nsec max. (CMOS level)
	Symmetry	50%±5% (1.4V level)	50%±5% (1/2 V_{DD} Level)
	Output Load	10TTL	50pF
INPUT	Input Voltage	V_L=0.8V max./V_H=2.2V min.	
	Input Current	I_L=100μA max./I_H=-150μA max.	
Output Enable Time (T_{PZL})		100nsec. max.	
Output Disable Time (T_{PZL})		100nsec max.	

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

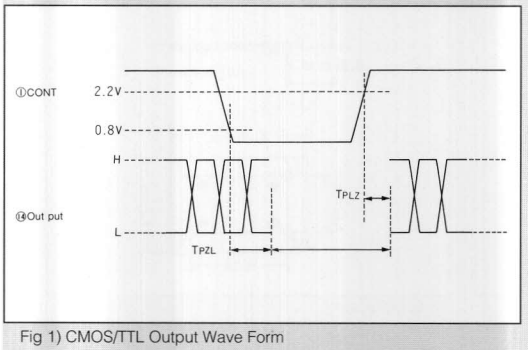


Fig 1) CMOS/TTL Output Wave Form

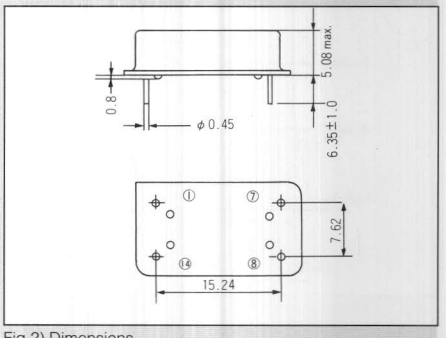


Fig 2) Dimensions

Function	Type	
Tri-state function	DOC-70ZA	DOC-70ZB
Non Tri-state function	DOC-70A	DOC-70B

Fig 1A) Function and Type

Pin Connections	
#1	COND
#7	GND (CASE GND)
#8	OUTPUT
#14	+5V DC

Fig 2A) Pin Connections

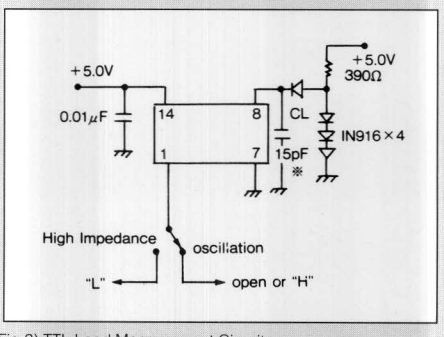


Fig 3) TTL Load Measurement Circuit

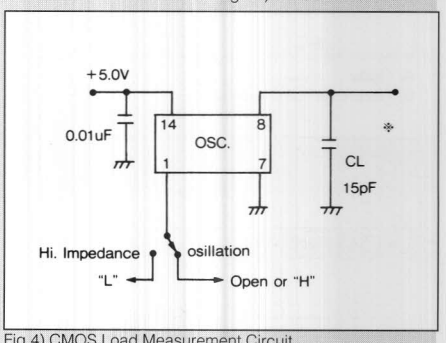
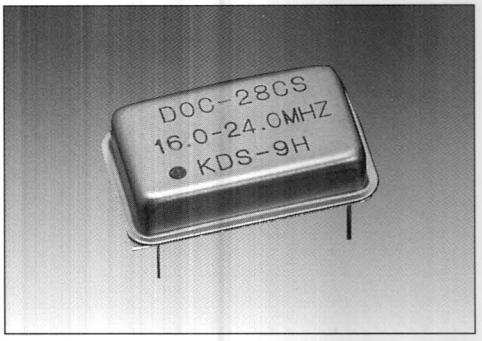


Fig 4) CMOS Load Measurement Circuit

DOC-28 Series



The KDS DOC-28 series is designed to drive microprocessors which require a MOS output and a TTL output.

SPECIFICATIONS

ITEM		DOC-28CS	DOC-28CSA	DOC-28CSE	DOC-28CSF
Output		C-MOS orTTL			
Output Frequency (See Note)		PIN #1 9.0~25.0MHz PIN #8 9.0~25.0MHz	PIN #1 9.0~25.0MHz PIN #8 9.0~25.0MHz	PIN#1 25.0~40.0MHz PIN #8 25.0~40.0MHz	PIN #1 9.0~25.0MHz PIN #8 25.1~40.0MHz
Frequency Tolerance		±100ppm/0°C~+70°C			
Operating Temp. Range		0~+70°C			
Storage Temp. Range		-30~+85°C			
OUTPUT	"0" Level	+0.5V MAX.			
	"1" Level	+4.0V min.			
	Rise and Fall Time (Tr, Tf)	15ns max./20~80%VDD at 50pF Load	10ns max./20~80% VDD at 150 pF Load 6ns max./+0.5~2.4V DC at 10 TTL Load	15ns max./ 20~80%VDD at 50pF Load	10ns max./20~80% VDD at 150pF (9.0~25.0MHz) & 120pF (25.01~40.0MHz) 6ns max./+0.5~2.4V DC at 10 TTL(9.0~40MHz)
	Output Load	50pF or 10LS TTL	150pF or 10TTL	50pF or 10LS TTL	150 pF/9.0~25.0MHz 120 pF/25.01~40MHz or 10 TTL/9.0~40MHz
	Symmetry	40/60~60/40% at 50% VDD DC Level			
Power Supply voltage		+5.0V±10% DC			
Current consumption		40mA max. (no Load)	60mA max. (No Load)	60mA max. (No Load)	60mA max. (No Load)

Note: Please specify two frequencies.

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

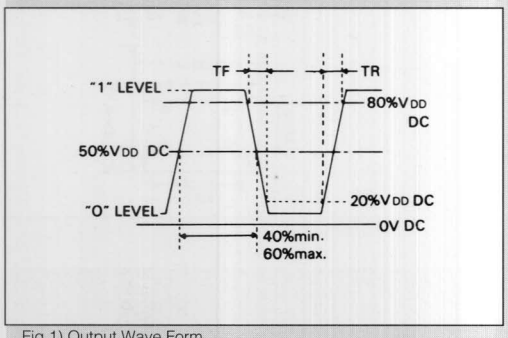


Fig 1) Output Wave Form

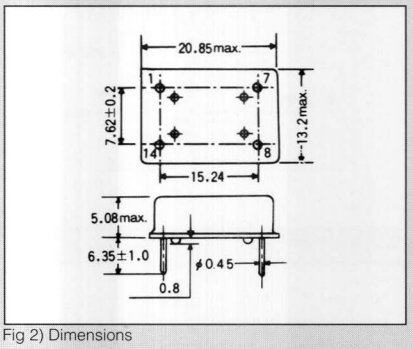


Fig 2) Dimensions

Pin Connections	
#1	OUTPUT 1
#7	GND (CASE GND)
#8	OUTPUT 2
#14	+5V DC

Fig 2A) Pin Connections

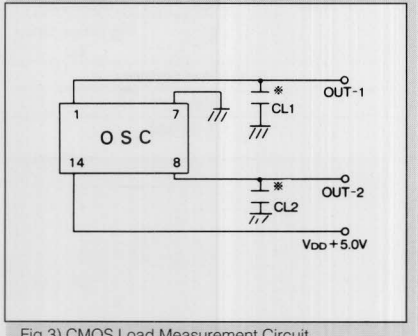


Fig 3) CMOS Load Measurement Circuit

Type	C_L1	C_L2
DOC-28CS	50pF	50pF
DOC-28CSA	150pF	150pF
DOC-28CSE	50pF	50pF
DOC-28CSF	150pF 9.0~25MHz	120pF 25.0~40MHz

Fig 3A) CMOS Circuit – C_L

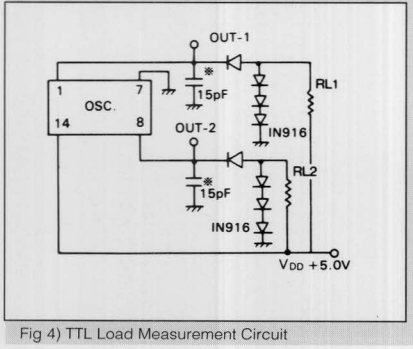


Fig 4) TTL Load Measurement Circuit

Type	R_L1	R_L2
DOC-28CS	1.5kΩ	1.5kΩ
DOC-28CSA	330Ω	330Ω
DOC-28CSE	1.5kΩ	1.5kΩ
DOC-28CSF	330Ω	330Ω

Fig 4A) TTL Circuit – R_L
(*Include oscillator, probe and stray capacitance @ 15pF.)

Clock Oscillator for "CPU 80386" DOC-386H3

This series has been especially designed for driving the "80386" CPU, conforming to the requirement of "80386" microprocessor. It is also convenient for automatic testing and maintenance with the tri-state function.

SPECIFICATIONS

ITEM		DOC-386H3	
Output Frequency		25~50MHz	
Frequency Tolerance		±100ppm/0°C~+70°C	
OUTPUT	Output Level	CMOS or TTL	
	"H" Level	+4.5V min./Vcc=+5.0V	
	"L" Level	+0.5V min./Vcc=+5.0V	
	Symmetry	50%±5%/2.0V DC Level	
	Rise and Fall Time (Tr, Tf)	8ns max. at 0.8~VDD-0.8V	
	Output Load (CL)	150pF or 5TTL	
	Tri-State Function	Function	
		Control #1 "H" or Open = Oscillation	
		Control #1 "L" = High Impedance	
Operating Temperature Range		0°C~70°C	
Storage Temperature Range		-55°C~+125°C	
Power Supply Voltage		+5.0V±10%	
Current Consumption		25~40MHz	60mA max.
Vcc: +5.0V No Load +25°C		40.01~50MHz	70mA max.

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

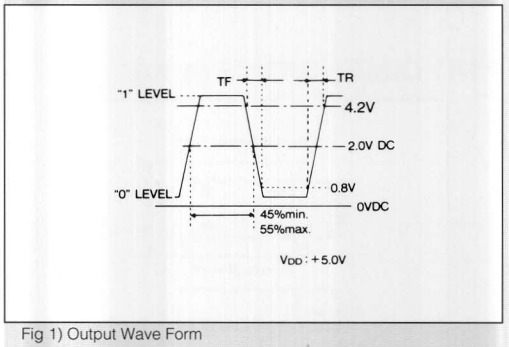


Fig 1) Output Wave Form

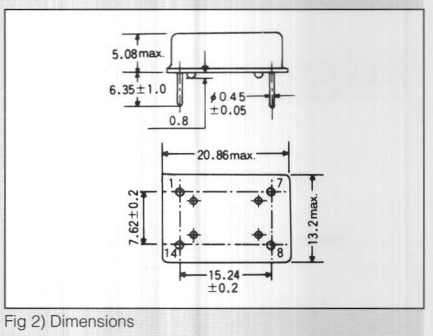


Fig 2) Dimensions

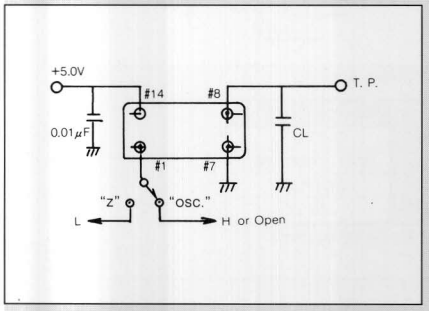


Fig 3) Measurement Circuit

PIN No.	Function		
#1	Tri- State	"H" or OPEN	Oscillation
		"L"	High Impedance (z)
#7	GND (Case GND)		
#8	Output		
#14	V_{DD} (+5.0V DC)		

Fig 2A) Pin Connections

SPECIFICATIONS

ITEM		DOC-120C
Output		HCMOS or TTL
Frequency Range		625kHz~25MHz
Frequency Tolerance		±50ppm or ±100ppm
Operating Temp. Range		0~+70°C
Storage Temp. Range		−55~+125°C
OUTPUT	"0" Level	+0.5V max. at V_{DD} 5V
	"1" Level	+4.5V min. at V_{DD} 5V
	Symmetry	60/40~40/60% (F≥10MHz) at 50% V_{DD} 55/45~45/55% (F<9.999MHz) at 50% V_{DD}
refer to Fig-1 Fig-3	Rise and Fall Time 10~90% V_{DD}	15ns max.
	Output Load	C_L=50pF or 2TTL
Power Supply Voltage		+5VDC±0.5V
Current Consumption		10mA max. No Load

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

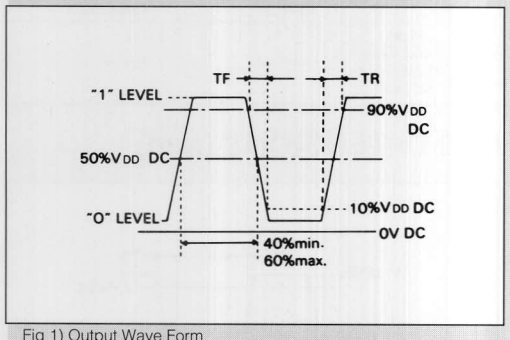


Fig 1) Output Wave Form

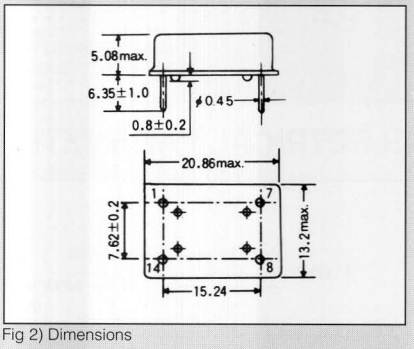


Fig 2) Dimensions

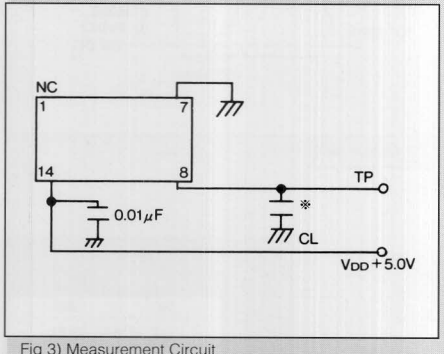
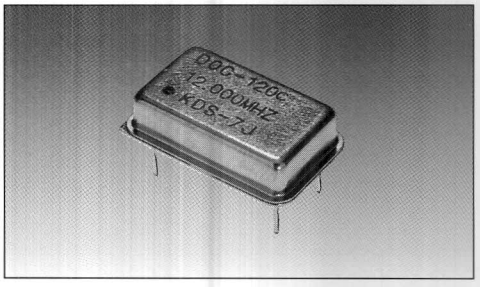


Fig 3) Measurement Circuit

Pin Connections	
#1	NC
#7	GND (CASE GND)
#8	OUTPUT
#14	+5V DC

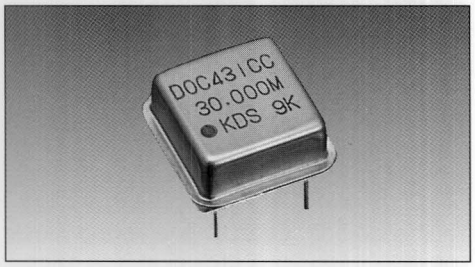
Fig 2A) Pin Connections

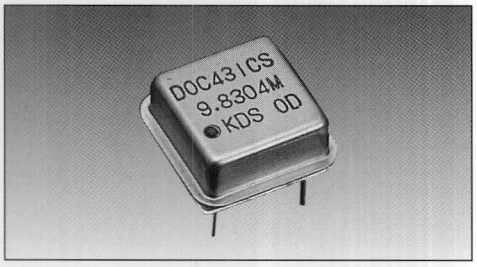
DOC-120C



The KDS DOC-120C is a hybrid clock oscillator capable of providing high speed CMOS circuitry and up to 2TTL. It can drive capacitive loads as high as 50pF. With the low current consumptions, the DOC-120C is suited well for low power CMOS applications.

Small DIP Type Clock Oscillator DOC-431 Series





This DOC-431 series metal package with 4-pin ground-to-case is half the size of our DOC 14-pin DIP packaging. This 8-pin DIP component is available with "stand-by" function on CS and CC models.

SPECIFICATIONS

TYPE		DOC-431CS	DOC-431CC	DOC-431TB	DOC-431TC
Output		CMOS or TTL	CMOS or TTL	TTL	TTL
Output Frequency		625KHz~25.0MHz	25.0~50.0MHz	4.0~23.9MHz	24.0~70.0MHz
Frequency Tolerance		±100ppm (including Operating Temperature Range)			
Operating Temperature Range		0°C~70°C			
Storage Temperature Range		-55°C~+125°C			
OUTPUT	"O" Level	+0.5V max.		+0.4V max.	+0.4V max./24.0~32MHz +0.5V max./32.01~70MHz
	"1" Level	+4.5V max.		+2.4V max.	
	Rise & Fall Time (Tr, Tf)	15ns max. (10~90% Vdd)	6ns max. (10~90% Vdd)	4.00~8.99MHz 15ns max. (0.4~2.4V) 9.00~23.99MHz 10ns max. (0.4~2.4V)	
		10ns max. (0.5~2.4V)	5ns max. (0.5~2.4)	24.00~32.00MHz 10ns max. (0.4~2.4V) 32.01~70.00MHz 6ns max. (0.4~2.4V)	
	Output Load	C_L=50pF or 2TTL	C_L=50pF or 5TTL	10TTL	10TTL
	Symmetry	F<9.99MHz 45/55~55/45 (50% V_{DD}) F≥10 MHz 40/60~60/40 (50% V_{DD})		40/60~60/40% (1.4V DC Level)	
Power Supply Voltage (V_{DD})		+0.5V DC ±0.5V			
Current Consumption		10mA max. (No Load V_{DD}+5V Ta=+25°C)	30mA max. (No Load V_{DD}+5V Ta=+25°C)	30mA max. (No Load V_{DD}+5V Ta=+25°C)	40mA max. (No Load V_{DD}+5V Ta=+25°C)
Stand-by Function		#1 pin (Control Term) Open or "H" "L"; #5 pin (Output Term) Oscillation "L" Level	#1 pin (Control Term) Open or "H" "L"; #5 pin (Output Term) Oscillation "H" Level	———	———

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

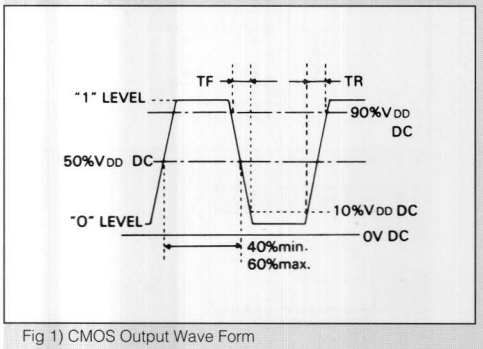


Fig 1) CMOS Output Wave Form

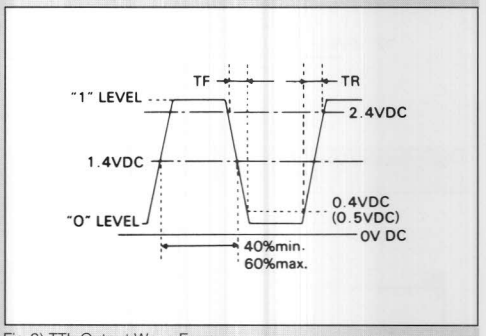


Fig 2) TTL Output Wave Form

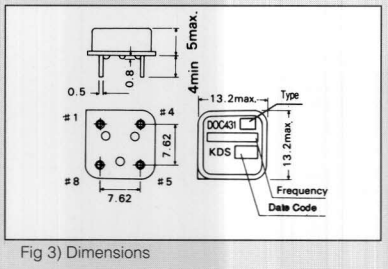


Fig 3) Dimensions

PIN	431TB 431TC	431CS 431CC
1	NC	INH
4	GND (CASE GND)	
5	OUTPUT	
8	+5V DC	

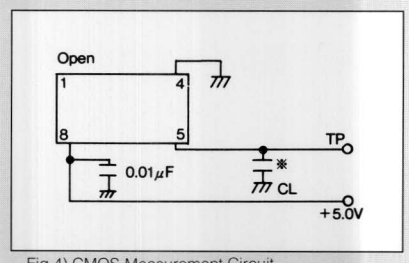


Fig 4) CMOS Measurement Circuit

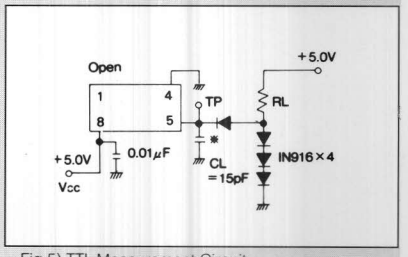


Fig 5) TTL Measurement Circuit

C_L	
DOC-431CS	50pF
DOC-431CC	15pF

Fig 4A) CMOS*

R_L	
DOC-431CS	2.0kΩ
DOC-431CC	820Ω

Fig 5A) TTL*

R_L	
DOC-431TB	390Ω
DOC-431TC	390Ω

* Includes probe and jigs capacitance.

SPECIFICATIONS

ITEM		DOC-431ZA	DOC-431ZB
Output		TTL	CMOS
Output Frequency		1.00-50.5MHZ	
Frequency Tolerance		±100ppm	
Operating Temperature Range		0°C~70°C	
Storage Temperature Range		-55°C~+125°C	
Operating Voltage		5V±0.5V	
Current Consumption		45mA max.	
OUTPUT	"0" Level	0.4V max.	
	"1" Level	V_{DD} X 0.9 min.	
	Rise and Fall Time (Tr, Tf)	5nsec. max. (TTL Level)	10nsec. max. (C-MOS Level)
	Symmetry	50%±5% (1.4 Level)	50%±5% (V_{DD} X 0.5V Level)
	Output Load (CL)	10TTL	50pF
	Input Voltage Level	V_{IL}=0.8V max./V_{IH}=2.2V max.	
	Input Current	I_{IL}=100μA max./I_{IH}=-150μA max.	
Ouptut Enable Time (T_{PZL})		100nsec. max.	
Output DIsable Time (T_{PZL})		100nsec. max.	

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

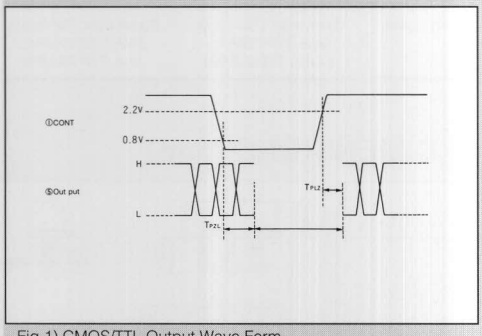


Fig 1) CMOS/TTL Output Wave Form

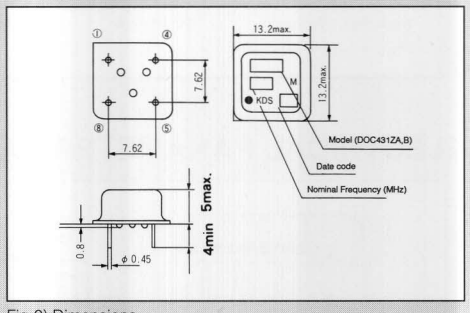


Fig 2) Dimensions

Pin connections	
1	Contact
4	GND (Case GND)
5	Output
8	+5V DC

Fig 2A) Pin Connections

Function	Type	
Tri-State function	DOC-431ZA	DOC-431ZB
Non Tri-State function	DOC-431A	DOC-431B

Fig 2B) Function

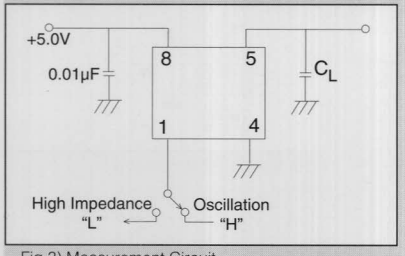
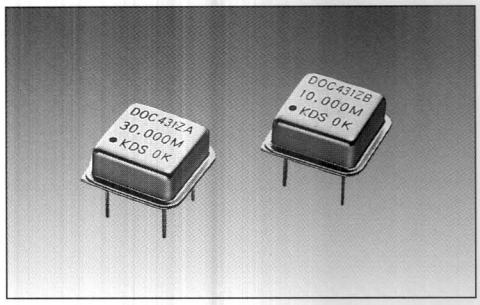


Fig 3) Measurement Circuit

Small Dip Type Clock Oscillator DOC-431 Z Series

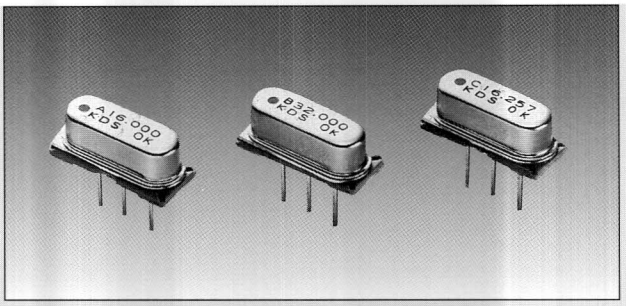


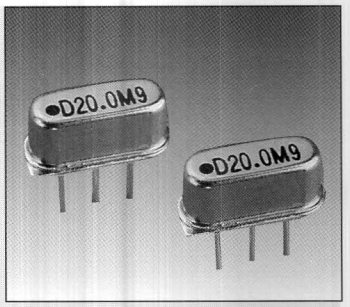
KDS half size oscillators are half the size of standard 14 pin dip oscillators to solve critical board space problems. The 8 pin dip DOC 431Z series design is compatible with TTL or CMOS circuitry and offers proven dependability.

Enable/Disable and Tri-State options are available to ensure compatability of this series with automatic test equipment. Employment of the tri-state function on model ZA and ZB controls the output. Applying logic "1" voltage level to pin 1 enables the oscillator output and logic "0" applied to pin 1 disables the output to a high impedence state.

Ultra Miniature Crystal Oscillator DOC-49S Series

This precision super compact crystal oscillator combines CMOS circuitry and low power consumption with dimensions 5 x 5 x 10mm. The DOC-49 series is an exceptional choice where space allocation is at a minimum. Great in lap-top computer and modem applications. This revolutionary development makes this series the world's smallest clock oscillator operating H-CMOS, CMOS and TTL logic.





SPECIFICATIONS

MODEL		DOC-49S1	DOC-49S2	DOC-49S3	DOC-49/SO-49	DOC-492/SO-492
Output		CMOS	CMOS or TTL	CMOS or TTL	CMOS or TTL	CMOS, H-CMOS or TTL
Frequency Range		156.25kHz~20.0MHz	20.1MHz~50MHz	1.25MHz~20MHz	156.25kHz~20.000MHz	625kHz~25MHz
Frequency Tolerance		±50ppm or ±100ppm	⇦	⇦	±50ppm± 100ppm (-10 ~+70°C)	"
Operating Temperature Range		-10~+70°C	⇦	⇦	-10~+70°C	"
Storage Temperature Range		-20°C~+80°C	⇦	⇦	-55~+125°C	"
OUTPUT	Output Level	CMOS	CMOS or TTL	CMOS or TTL	CMOS	"
	"0" Level	0.5V max.	⇦	⇦	0.5V max.	"
	"1" Level	4.5V min.	⇦	⇦	4.5V min.	"
	Symmetry 2.4V DC Level	40~60% ≥10MHz 45~55% <10MHz	40~60%	40~60% ≥10MHz 45~55%<10MHz	40~60% ≥10 MHz 45~55% <10MHz	40/60%≥10 MHz 45/55%<10MHz
	Load	CL=15pF or2LS-TTL	CL=15pF or 2LS-TTL	CL=50pF or 10LS-TTL	CL=15.0pF or 2LS-TTL	CL=50pF or 10LS-TTL
	Rise and Fall Time (Tr, Tf)	50 nsec max. <2MHz 20 nsec max. ≥2MHz	10 nsec max.	15 nsec max.	50nsec max. <2.0MHz 20nsec max. ≥2.0MHz	15nsec max.
Supply Voltage		5±0.5V				
Supply Current		5mA max. (No Load)	25mA max.	10mA max. (No Load)	5mA max. (No load) 3mA TYP/10MHz, 4.5mA TYP/20MHz	10mA max. (No load) 3mA TYP/10MHz, 7mA TYP 25 MHz

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

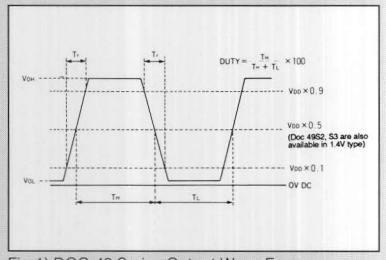


Fig 1) DOC-49 Series Output Wave Form

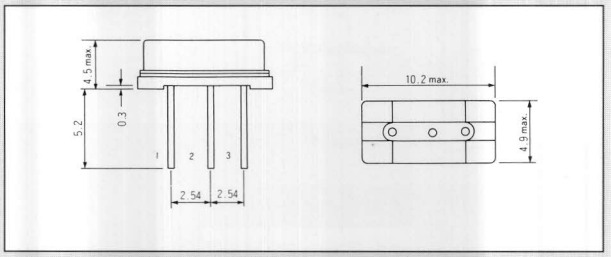


Fig 2) DOC-49S Series Dimensions

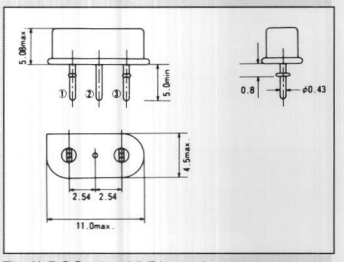


Fig 3) DOC-49, 492 Dimensions

Pin Connections	
#1	5V DC
#2	GND (CASE)
#3	OUTPUT

Fig 4) Pin Connections

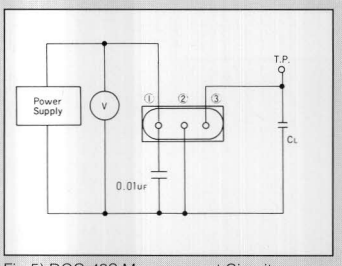


Fig 5) DOC-49S Measurement Circuit

	C_L
DOC-49	15 pF
DOC-492	50 pF
DOC-49S1	15 pF
DOC-49S2	15 pF
DOC-49S3	50 pF

Fig 5A) C_L (Includes probe and jig capacitance)

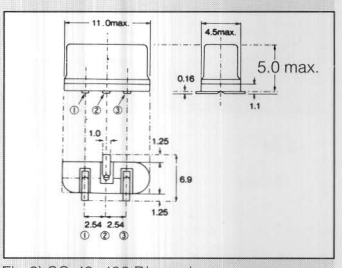


Fig 6) SO-49, 492 Dimensions

SPECIFICATIONS

MODEL	DOC-10K
Output	High Speed ECL 10KH
Output Frequency	70~200MHz
Operating Voltage (Vee)	-5.2V ±10%
Maximum Supply Voltage	8.0V
Operating Temperature Range	0~70°C
Storage Temperature Range	-10~80°C
Frequency Stability	±50ppm or ±100ppm
Current Consumption	60mA max.
Output Load	ECL (50Ω, -2.0V)
Symmetry	60/40%~40/60%/-1.3V DC
Rise and Fall Time (Tr, Tf)	2 nsec max. /20~80%
Output Voltage	ECL Level VoH-1.15V~-0.67V VoL-2.03V~-1.54V

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

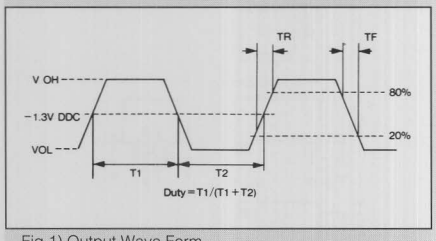


Fig 1) Output Wave Form

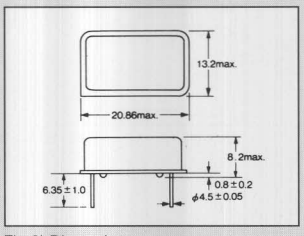


Fig 2) Dimensions

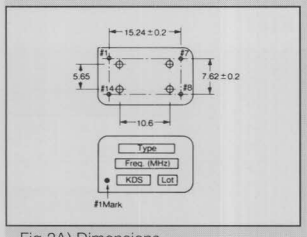


Fig 2A) Dimensions

Pin	DOC-10K	DOC-10K1	DOC-10K2
#1	NC	CASE GND	CASE GND
#7	GND (OV) (CASE GND)	Vee (-5.2V)	Vcc (OV)
#8	ECL OUT	ECL OUT	ECL OUT
#14	Vee (-5.2V)	Vcc (OV)	Vee (-5.2V)

Fig 2B) Pin Connections

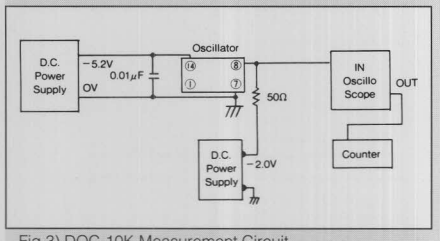


Fig 3) DOC-10K Measurement Circuit

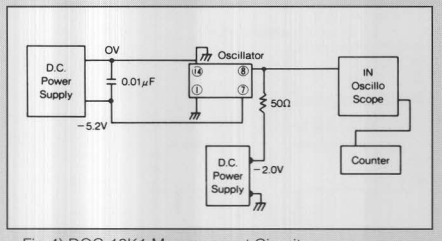


Fig 4) DOC-10K1 Measurement Circuit

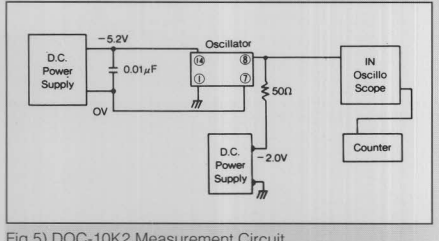
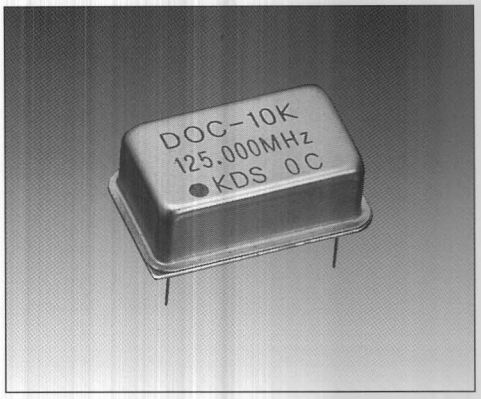


Fig 5) DOC-10K2 Measurement Circuit

Emitter Coupled Logic (ECL) Clock Oscillators DOC-10K Series



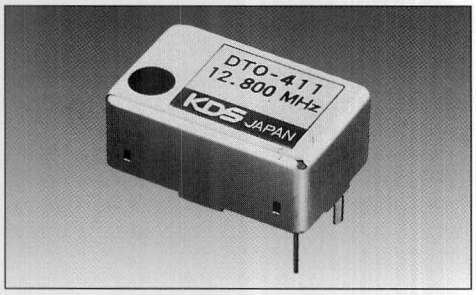
KDS ECL oscillators are low level, high speed, clock oscillators designed for high speed emitter-coupled logic families of chips, operating in the range from 70 to 200MHz. The DOC-10K Series provides rise and fall times of less than two nanoseconds, with excellent duty cycle, noise-margins and power supply noise detection.

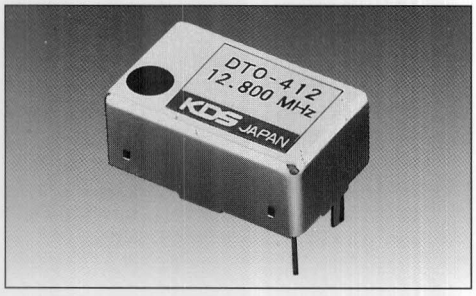
This series has 10K, 10K1 and 10K2 stating different configurations.

These units are "10KH Logic Output Compatible". Applications include high resolution video displays for high end graphic workstations, very high speed "mini-computers", high speed data acquisition for digital processing, aerospace, test and measurement systems and RF communications.

Contact your local KDS representative to discuss your special requirements.

Temperature-Compensated Clock Oscillators (TCXO) DTO-Series 112NY, 213, 231, 233, 411, 412





KDS compact temperature compensated clock oscillators are available in two supply voltage types, 4 volts and 5 volts and measuring as low as 8.0mm in height.

With frequency stabilities of 2.5ppm and current consumption as low as 3mA maximum, these high precision oscillators have been designed for use in facsimile machines, computers, mobile and cordless telephones and cellular telephones.

SPECIFICATIONS

TYPE	DTO-112NY	DTO-213	DTO-231	DTO-233	DTO-411	DTO-412
Frequency	24.00014MHz	4~17MHz	12.8MHz	9.0MHz	12.800MHz	
Freq. Stability vs Temp.	±5.0ppm/0~+60°C	±5.0ppm/0~+50°C	±2.0ppm/-10~+60°C	±2.5ppm/-30~+60°C	±3.5ppm/-10~+50°C	
Freq. Stability vs Vcc	±1.0ppm/Vcc±5%	±0.5ppm/Vcc±5%	±0.3ppm/Vcc±5%	±0.3ppm/Vcc±5%	±0.3ppm/Vcc 5%	
Power Supply Voltage (Vcc)	+5V±5%	+5V±5%	+5V±5%	+5V±5%	+5V±5%	+4V±5%
Current Consumption	10mA max.	10mA max.	5mA max.	5mA max.	3mA max.	
Output Load	15pF	15pF	1Vp-p min. DC cut RL=20KΩ//5pF	CMOS	1V<p-p>min. DCcut 10KΩ//10pF	
Symmetry	40~60%/+2.5V Vcc=5.0V	40~60%/+2.5V Vcc=5.0V	N/A	N/A	N/A	
Oper. Temp. Range	-10~+70°C	-20~+70°C	-25~+70°C	-40~+80°C	-25~+70°C	
Freq. Adjustment	±5ppm min.	±5ppm min.	±3ppm min.	±3ppm min.	±3ppm min.	

DIMENSIONS (mm)

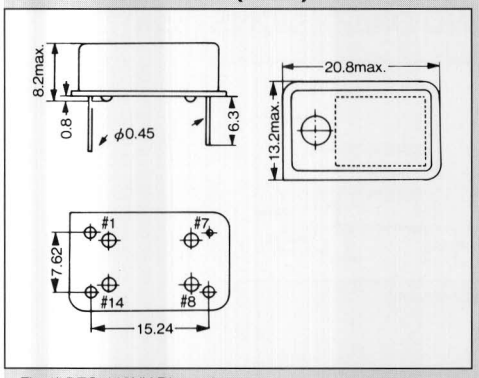


Fig 1) DTO-112NY Dimensions

Pin Connections	
#1	NC
#7	GND (CASE GND)
#8	OUTPUT
#14	+Vcc

Fig 1A) Pin Connections

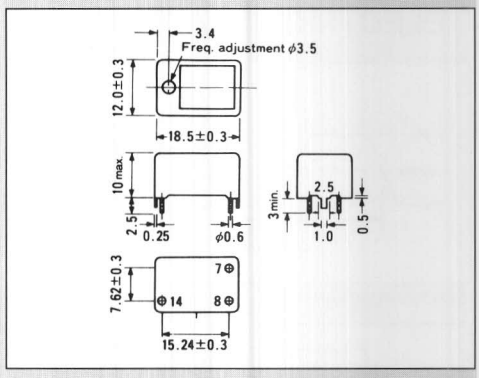


Fig 2) DTO-231 Dimensions

Pin Connections	
#7	GND (CASE GND)
#8	OUTPUT
#14	+Vcc

Fig 2A) Pin Connections

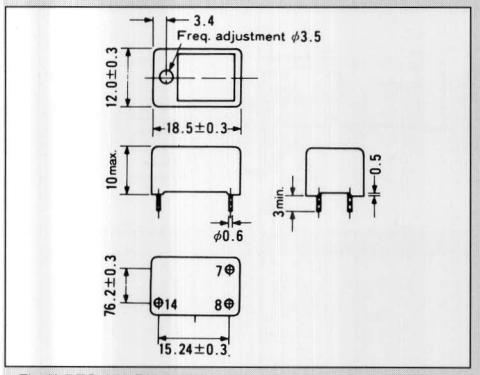


Fig 3) DTO-213 Dimensions

Pin Connections	
#7	GND (CASE GND)
#8	OUTPUT
#14	+Vcc

Fig 3A) Pin Connections, DTO-213 and DTO-411/412

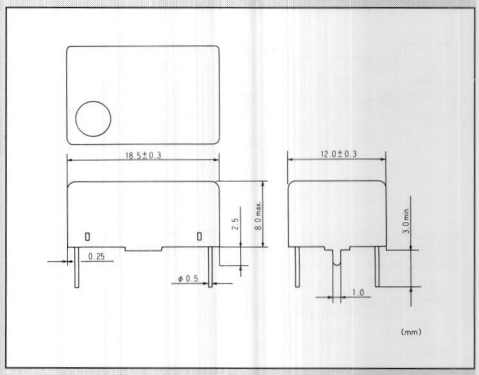


Fig 4) DTO-411/412 Dimensions

1. Frequency _____
2. Operating Temperature _____ °C to _____ °C
3. Overall frequency stability ± _____ ppm or _____ %
4. Package type ☐ 14 pin ☐ 8 pin ☐ DOC-49 ☐ Other, specify _____
5. Input voltage (Vcc) _____ V
6. Current Consumption _____ mA Maximum
7. Symmetry _____
8. Rise Time _____ ns Maximum
9. Tri-State ☐ No ☐ Yes
10. Dual Output ☐ No ☐ Yes, if Yes, Frequency pin 1 _____
11. Output Type: TTL _____ CMOS _____ HCMOS _____ Other/Specify _____
12. Other: Describe in detail any specific parameters that are essential to the performance of the oscillator in your specific circuit. _____
13. Delivery requirements ☐ Immediate ☐ 3 months ☐ 6 months ☐ Longer
14. Quotation required by _____
15. Quote on quantities through _____
16. Application intended for _____
17. Are samples required ☐ No ☐ Yes. If so, by when _____
18. Annual usage _____
19. Attach engineering drawing if available

QUESTIONNAIRE HAS BEEN COMPLETED BY

Name _____ Title _____
Company _____
Address _____
City _____ State _____ Zip _____
Phone _____ FAX _____
Signed _____ Date _____

(Please reproduce and forward to engineer's attention.)

KDS AMERICA
10901 Granada Lane
Overland Park, KS 66211
(913) 491-6825 • FAX (913) 491-6812

KDS AMERICA
17151 Newhope Street, Suite 210
Fountain Valley, CA 92708
(714) 557-7833 • FAX (714) 557-4315

Oscillator Specification Ordering Guide

Although KDS manufactures a wide variety of standard clock oscillators, our customers frequently have a special application. If you do not find the clock oscillator you need after reviewing this catalog, please complete the following list of your required oscillator parameters and we will gladly supply you with a price and delivery quotation.

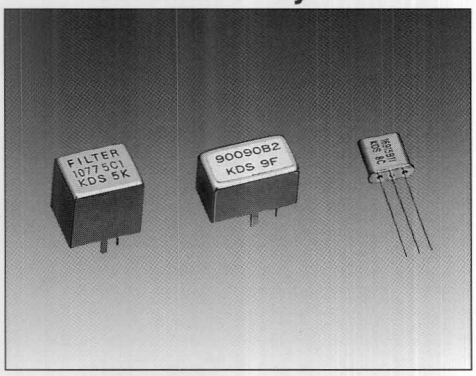
Availability and Test Data

A wide variety of KDS oscillators are available for immediate delivery. Quantities in stock and delivery schedules will vary by product, so ask your KDS representative for details on specific part numbers.

CHARACTERISTICS	
ENVIRONMENTAL	
Temperature Cycle	±5ppm max. at 25°C reference when measured after 0 to 120°C, 3 cycles, 2 hours max. each cycle.
Shock	±5ppm max. after 1000G 0.35mS, 1/2 sine wave, 3 shocks each plane.
Vibration	±5ppm max. after 10-55Hz, 0.60" D.A., 55-200Hz, 35G, duration time 12 hours.
Humidity	±5ppm max., 85% relative humidity, 85°C, 250 hours.
MECHANICAL	
Gross Leak Test	All units 100% leak tested in de-ionized H_2O
Hermeticity	Leak rate less than 2 x 10-8 atoms, cc/sec of helium.
Seal Strength	20lbs. min. force, perpendicular to top and bottom.
Lead Bend Test	Will withstand maximum bend of 90° reference to base for two bends.
Marking Ink	Ultraviolet cured ink
Solvent Resistance	Isopropyl alchohol, trichloroethane – no marking or seal destruction, dipped 1 minute, +25°C ±5°C in solvent.

Filters – Terms and Definitions

Monolithic Crystal Filters



The basic building block for all packaged crystal filters is the two-pole monolithic filter.

Two-pole monolithic filters can be cascaded to produce four, six and eight or more pole filter responses with the addition of coupling capacitors between two-pole sections.

KDS produces many types of applications. Wide or narrow band filters for mobile, UHF, cordless telephone projects, and single side band applications.

Frequency range is from 10.7MHz through 100.00 MHz with various channel spacing requirements.

DEFINITIONS

Critical to the understanding of filter behavior is a definition of the vocabulary of the most frequently used terms and familiarity with the typical filter amplitude frequency response curve (Figure 1).

a. **Center Frequency (fo):** The arithmetic mean between the high and low cut off frequencies of a filter.
b. **Bandwidth (BW):** The difference between two cut off frequencies at a specified attenuation level (3dB or 60dB).
c. **Attenuation:** Reduction of signal in transmission through a filter. (Attenuation is usually expressed in decibels (dB).
d. **Decibel:** Unit that expresses the ratio between two powers, two voltages or two currents

$$(10 \text{ Log } \frac{P_1}{P_2}, 20 \text{ Log } \frac{V_1}{V_2} \text{ or } 20 \text{ Log } \frac{I_1}{I_2}).$$

e. **Shape Factor:** Ratio of bandwidths at two different levels of attenuation.
f. **Ripple:** The wavelike response in the passband of a filter (expressed in dB). Unless otherwise specified the maximum ripple will be that excursion from the highest peak to the lowest valley.
g. **Insertion Loss:** Power loss of the filter in the passband (expressed in dB). Zero dB reference shall be the point of maximum output of the filter unless it is specified otherwise.

$$\text{Insertion Loss} = 10 \text{ Log } \frac{P_{in}}{P_{out}}$$

h. **Source Impedance:** (Input termination) – The output impedance of the circuit that drives the filter.
i. **Load Impedance:** (Output termination) – The impedance that must be connected to the output terminals of the filter in order to achieve the proper response.
j. **Spurious Mode:** Unwanted responses that occur in the filter due to resonant frequencies of the crystal other than the fundamental frequency.

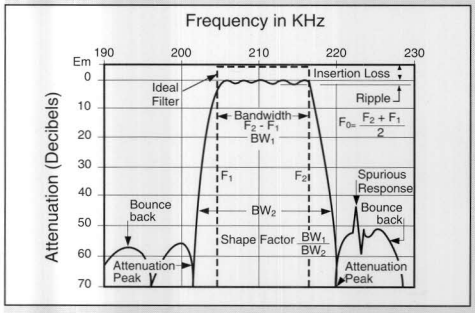


Fig. 1) Typical Filter Response Curve-Bandpass Filter

Crystal filters from 1KHz to 150MHz are manufactured to customer's requirements or to MIL-specifications.

Computer-aided design programs and production techniques provide various precision filters with sharp cut-off characteristics, long-term stability, wide termperature range, minimum insertion loss and high stop-band performance.

- FM receivers of single and double super-heterodyne
- In mobile and other equipment
- SSB signal generation
- Extraction or rejection of pilot signal
- Telephone channel filtering
- Other frequency controls

Center Frequency: Bandwidth Theoretical Shape Factor

The center frequency-bandwidth charts and shape factor charts shown below can be used in determining center frequency versus bandwidth characteristics.

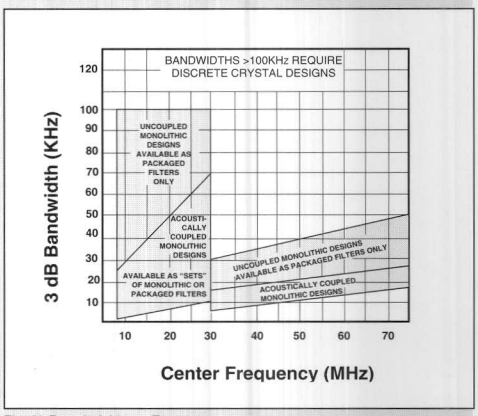


Fig 2) Bandwidth vs Frequency

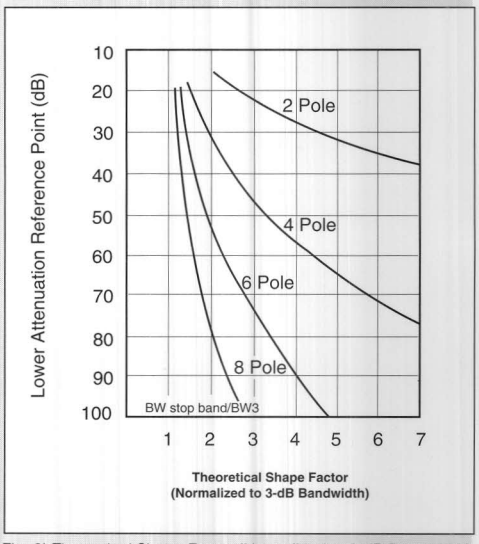


Fig. 3) Theoretical Shape Factor (Normalized to 3-dB Bandwidth)

Customer Specifications or Drawing #

1. Holder/Case Size _____
2. General type: ☐ Monolithic Filter ☐ Discrete Filter ☐ Filter Crystal
3. Number of Poles _____
4. Center of Frequency _____
5. Passband Characteristics (dB) _____ KHz _____
6. Stopband Characteristics (dB) _____ MHz _____
7. Ripple Maximum (dB) _____
8. Insertion Loss (dB) _____
9. Attenuation (dB) _____
10. Spurious Response (dB) _____
11. Group Delay Distortion (ms) _____
12. Terminal Impedance _____
13. Test Fixture (test circuit) _____
14. Operating Temperature Range _____ °C to _____ °C
15. Other, if any _____

    Quantity Required _____

    Requirement Schedule _____

QUESTIONNAIRE HAS BEEN COMPLETED BY

Name _____ Title _____

Company _____

Address _____

City _____ State _____ ZIP _____

Phone _____ FAX _____

Signed _____ Date _____

(Please reproduce and forward to engineer's attention.)

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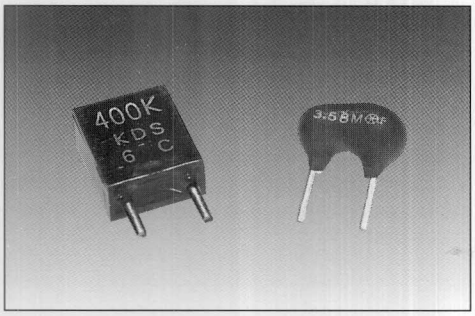
Filter Specification Ordering Guide

Although KDS manufactures a wide variety of standard filters, our customers frequently have a special application. If you do not find the filter you need after reviewing this catalog, please complete the following list of your required filter parameters and we will gladly supply you with a price and delivery quotation.

Piezo Ceramic Resonator



The inexpensive piezo ceramic resonators are an ideal replacement for quartz crystal units when high stability is not a requirement.

KDS offers these components in a frequency range from 190KHz through 22.00MHz with temperature stabilities at ±0.3%.

The PCS miniature is an excellent choice for its temperature and shock characteristics.

SPECIFICATIONS (Low Frequency)

CASE	FREQUENCY (kHz)	STANDARD FREQUENCY (kHz)	RESONANT RESISTANCE (Ω)	C_1 (PF)	C_2 (PF)	W	H	T	L	I	E	S
A	768~1250	800	50	100	100	4.5	6.0	3.0	3.5	0.3	0.6	2.54
B	430~767	455, 480 500, 600, 640	20	100	100	7.0	8.5	3.5	3.5	0.3	0.8	5.08
C	375~429	390, 400	20	120	470	7.9	9.4	3.8	4.3	0.3	0.8	5.08
D	250~374	300	20	220	470	10.8	12.3	3.8	6.7	0.3	0.8	7.52
E	190~249	200	20	330	470	13.5	15.0	3.8	9.0	0.3	0.8	10.16

• Frequency tolerance ±0.5% • Temperature stability ±0.3% • 10 years aging ±0.5% service temperature -20~+80°C

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

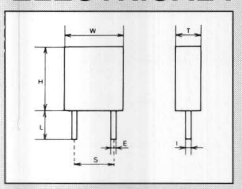


Fig 1) Dimensions

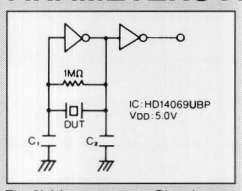


Fig 2) Measurement Circuit

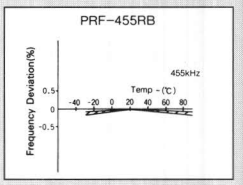


Fig 3) Temp. Characteristics

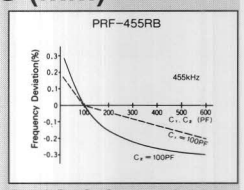


Fig 4) C_1, C_2 Characteristics

SPECIFICATIONS (High Frequency)

CASE	FREQUENCY (MHz)	RESONANT RESISTANCE (Ω)
PRS	2.0~6.0	30*
PRT	7.3~12.0	30
PRO	10.0~22.0	40

Service temperature -20~+80°C

PRO Series C1, C2 Value	
F (MHz)	C_1=C_2 (pf)
10~14	220
14~18	150
18~22	100

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

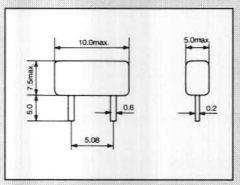


Fig 5) PRS Dimensions

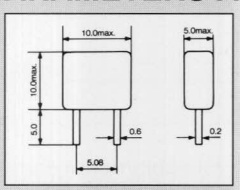


Fig 6) PRT, PRO Dimensions

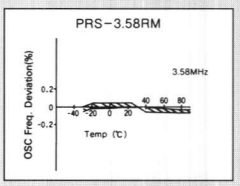


Fig 7) Temp. Characteristics

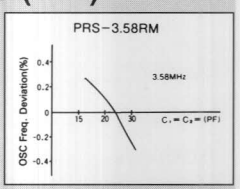


Fig 8) C_1, C_2 Characteristics

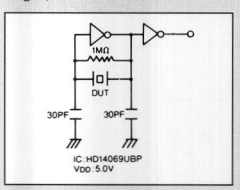


Fig 9) PRS

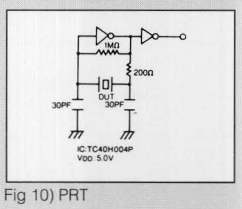


Fig 10) PRT

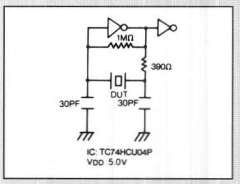


Fig 11) PRO MOS

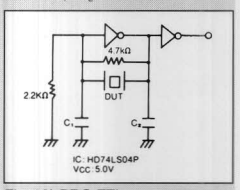


Fig 12) PRO TTL

SPECIFICATIONS (Capacitated Ceramic Resonators)

CASE	FREQUENCY (MHz)
PCS	2.0~6.0
PCT	7.3~12.0

ELECTRICAL PARAMETERS AND DIMENSIONS (mm)

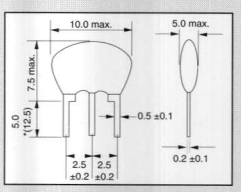


Fig 13) PCS Miniature

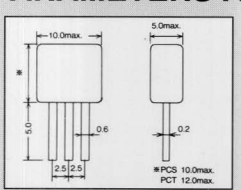


Fig 14) PCS, PCT Dimensions

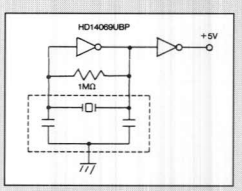


Fig 15) PCS

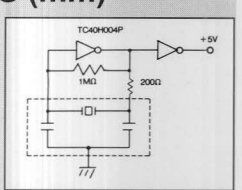


Fig 16) PCT

* Available in reel or tape (lead length is 12.5mm).

KDS design teams integrate our cultured quartz blanks and other KDS manufactured materials to produce finished components with consistent quality and superior aging characteristics. Since we know that replacement of failed components increases your total operating costs, we will recommend only sound, producable designs that have already met our exacting standards.

Should you find one of our products does not meet your expectations, please let us know immediately. In many cases an exchange of further information can prevent unnecessary time delays and expenses.

Care and Handling

All KDS frequency control crystals are hermetically sealed to prevent premature aging and add to environmental stability. Check product specifications in this catalog or consult your KDS sales representative for details on the best product for your application. These sealed units require care in handling and mounting to prevent damage to the sealed unit. Avoid excessive pressure applied to the pins. Do not bend wire leads tight against the header. Care must be taken in soldering to the enclosure in order to keep temperatures low enough to avoid melting the internal crystal mounting structure. Failure to follow these precautions could result in damage to the seal and loss of the dry gas.

Insurance

KDS—America insures all shipments for the full value of the order unless otherwise specified by the customer in writing. Should your shipments be covered by your internal insurance policies, we will purchase minimum coverage to guarantee traceability of your shipment in case of loss. We will add the cost of this coverage to your charges.

Terms

All shipments are made F.O.B. Overland Park, Kansas or Fountain Valley, California unless previously agreed to in writing by KDS—America.

We will be happy to establish an open account for your company upon approval of your credit application. On your company letterhead, please submit three references along with your request.

For prompt shipment where a credit check could delay order processing, we suggest either a company check or C.O.D. with your order.

Warranty

All products from KDS—America are warranted against defects in materials and workmanship for a period of one year from the date of shipment to the original purchaser. The warranty is non-transferrable and does not apply to cases of abuse, negligence or accident. All claims for damage in shipment should be made to the carrier with advice to us so we can verify your claim.

Return authorization and instructions must be obtained from the factory prior to return shipment.

Return goods should be shipped prepaid. If repairs are covered by warranty, we will pay all charges to ship goods back to you.

Returned goods should always be packed carefully to avoid further damage. Analysis of returned products allows us to prevent future problems.

We shall at our option, repair or replace any KDS product which proves defective during the warranty period upon its return to the factory. KDS is not liable for consequential damages. No other warranty is expressed or implied.